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Electrical World

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The Coal Situation

NOTWITHSTANDING Mr. Cushing's assurance to the Ohio Electric Light Association that there is no shortage of coal and that the industry is being unnecessarily harangued on the coal situation, the outlook is not very bright. On top of an already acute transportation situation comes the strike of the miners in the Middle West, which only serves to add to the predicament. Every effort should therefore be made by electric public utilities to obtain coal not only for present consumption but also for storage, despite the high cost of the fuel. While it is particularly galling to a utility to be compelled to pay from $15 to $20 a ton for coal which during the war was obtainable at one-third that price, it is nevertheless obligatory on the industry to give service and apply to the commissions for increased rates to cover the added operating expense. Nor will it be an easy matter to obtain coal. The recent ruling of the Interstate Commerce Commission whereby the Northwest and New England must be supplied with fuel during the summer months, and the priority order issued by the same body affecting public utilities during times of emergency, constitute heavy liens upon coal production, so that there will be no very large equity left for other purposes. On the other hand, production is increasing and, barring strikes, will continue to increase. It is therefore expedient for public utilities to do everything possible to store coal during the summer months, and it must not be overlooked that coal for storage will have to be bought in competition with other industries likewise endeavoring to provide for their future needs.

The Return to Normal

PROSPECT of an old-fashioned campaign for the Presidency, on time-honored partisan lines, with the dreaded new third party a laughing-stock, the Socialists subdued and sober and the advocates of communistic revolution in peril of that banishment from newspaper headlines, which to them is exile, surely marks the beginning of the subsidence in the United States of the noisy unrest that always follows war. In desolated Europe the commotion may continue long, but in America its echoes are already dying away. Prosperity and revolution do not run together; and, despite high prices, despite the scarcity of dwellings, despite disorganized industries and inadequate products, it is only necessary to glance around to see a majority riot of cheerful expenditure and determined enjoyment that may be deplorable in some of its aspects but has at any rate nothing in common with despair or gloom. Underneath political effervescence of every kind lies, too, a solid substratum of common-sense patriotism that defies the upsetters.

"Here is what moves in magnificent masses, careless of particulars—
The Union, always swarming with blatherers and always sure and impregnable.'

The outlook in the fall elections is for the triumph of the average man in nation, state and municipality. There are disadvantages in his victory, but, after all, it is what democracy spells, and out of it will come gradual adjustments to the new money values and the new wage tariffs and the new world relationships that will bring substantial justice to almost all, including, let us hope, the public utilities now so heavily handicapped.

Education of Labor a Good Investment

TO PROVIDE an incentive for doing better and more work, shop facilities at the Lynn (Mass.) works of the General Electric Company include a remarkably wide range of educational opportunities. Richard H. Rice, manager of this plant, has declared that the application of the Golden Rule in the treatment of labor lies at the foundation of successful production. Manufacturers are today virtually in competition for labor, and the provision of educational and social opportunities, combined with healthful and attractive working conditions, is "good business," wholly apart from ethical considerations. Workers at Lynn who show a desire to advance are taught to operate machines of increasing complexity, and the educational facilities of the plant embrace a wide range from courses adapted to fitting technical graduates for drafting and designing engineering to instruction in individual tool operation, training for foremen, and fitting men for larger executive tasks. More than ever, community interest and sympathy are sought by the manufacturing company, and false ideas are combated by frankly meeting employees, co-operating along educational lines, making the plants "good places in which to work," and in many other ways.

Safety of Electrical Investments

STEEL production and agriculture have long been the basic industries of the nation, and to them should now be added the electrical industry. For were it not for the electric spark in the motor truck which hauls the steel products, electric lighting to make possible effective continuous work, the electric motor to drive the rolls, and the electric testing devices to check the product, the steel production of today would be impossible. As to agriculture, particularly in those parts of the country where pumped water is vital for irrigation, electric power is not only accomplishing wonders but upon it all plans for extensions to the cultivated area are based. In the home also electricity has become so important that no household is complete without its aid. The stocks and bonds of the electric utilities have a security, therefore, greater than that of others. Not only are the securities assured by tangible assets in power plants and lines, but, more than all, by vital and essential service to the human race.

Determining Cost Prices

AMONG many suggested preventives for profiteering is a proposal to compel by law the marking of its cost price on the article offered for sale. This brings up the interesting question, "What is the cost price?" No two individuals, no two shop cost systems, would define it the same way. It would seem, therefore, that such a law would have to establish a cost-keeping system for every kind of shop in each industry. While a procedure of this kind would probably cost as much or more than any price reduction, it would without question throw a great deal of light on inefficiency and waste and place competition on a fair basis.

Corrective methods for high prices and punishment for profiteers certainly deserve attention in many industries. From such investigations the electrical industry has little to fear, for no other business has been so remarkably free from profiteering. However, to harass all industries by inflexible price control laws will never accomplish the results that might be attained through action that on sufficient evidence can now be exercised by our criminal courts.

Opportunity for Standardizing Industrial Substations

SUBSTATIONS for the supply of industrial power and lighting differ in principle very little from those supplying miscellaneous service. The transforming equipment is substantially the same. Safety and control equipment is of much the same nature, and the general principles of location remain unchanged whatever the purpose to which the secondary current is applied. The industrial plant, from its limited range of distribution, generally does not require any special provisions for feeder regulation, and as a rule there are fewer high-tension feeders with their necessary equipment. The paper by R. H. Tillman in this issue contains a very practical account of industrial substation design, one particularly useful because it gives information regarding present construction costs. These run, for a substation housed in a regular building, somewhere in the vicinity of $15 per kva., of which the building can be brought down to somewhere near 10 per cent. Of course, the amount of transforming apparatus in the station affects the cost considerably.

The economy to be obtained by the use of outdoor substations varies much with conditions involving the complexity of the necessary equipment. The transformers and their auxiliaries being the main item in the total, the saving by abolishing the substation building is not very large, and probably the removal of temptation for the installation of unnecessary equipment plays a larger part in the economies of the outdoor substation than does the mere abolition of the walls. Mr. Tillman takes up the principles of substation design in a way that will prove most instructive, and it is certainly grateful to have data on recent costs collated and tabulated. Labor and material have advanced so rapidly in the past three or four years that all old figures must be thrown into the discard and a completely new schedule established.

Since service to industrial plants from individual substations is greatly increasing, it seems that there is an excellent opportunity for central stations to reduce the time and cost of establishing service by adopting a few standard forms of construction for such stations. By so doing special engineering work on each job can be avoided and stock parts can be kept on hand so that when service is required type A, B or C station can be ordered and quickly installed.

Economies in Storeroom Stocks

IT IS an odd fact that in the handling of the cash drawer the utmost precautions are taken by most central-station companies to prevent losses, while in the handling of supply stocks, which are essentially cash, cases of the utmost carelessness are constantly observed. The storeroom is frequently a serious offender, the offence consisting of careless methods of handling and accounting and the purchasing and carrying in stock of unnecessary items. One central station has been able after a careful study to reduce the number of distribution brackets in use from thirty-nine to eleven types. It was found that the large number of types in use was due to the individual preferences of the construction and maintenance forces and that orders were frequently placed when material that was usable was actually in stock. One of the easiest methods of reducing storeroom stocks and therefore reducing the cost of storeroom service and releasing capital for other necessary uses lies in a careful study of the ways and means of using material in construction work. Not only is investment cut down but the handling of material is simplified because there are fewer items and the simplifications lead to lower costs of handling. In these days of enforced economies and need for standardization, a strong N. E. L. A. committee can serve the industry well and profitably not only for the present but later as well.

Conditioning Big Motors to Assure Reliable Service

OF ALL the uses to which electric motors are put the operation of steel mills is perhaps the most strenuous. Not only are the machines big, up to 10,000 hp. or more in maximum output, but they have to endure mechanical strains of exceptionally severe character and suffer to an unusual degree from chances of dirt and moisture affecting the insulation. O. Needham contributes to this issue some very practical suggestions for the testing and inspection of this class of motors prior to installation and periodically thereafter.

The mere trying out of a machine which has remained for some time uninstalled or unused is no trifling matter. Mr. Needham's instructions for carrying on the drying process afford some useful details in the carrying out of the methods ordinarily employed. The combination of exterior heat and heating current is particularly useful in dealing with great moisture, since the external heating can bring the coils into condition for the application of heating current when otherwise some risk would be incurred. By coupling the process with insulation measurements the progress of the work can be followed up, and finally low-voltage current can be applied until the resistance becomes entirely steady. After this an actual overvoltage test with a small transformer will bring the process to a suitable end.

Once in action again, steady care is the main requirement for continuous operation. Mr. Needham's suggestion of inspection and blowing out by air pressure every week or two, together with at least an annual

treatment with insulating varnish as far as the insulation can be reached, is a good one. Many a hard-worked motor has finally struck, not from unpreventable faults, but from dirt, moisture and general neglect. At the present price of motors rigorous inspection pays.

Engineering Reticence

THE personal quality of reticence is one which has long been associated with the engineering profession. "To do much and say little" has been almost an axiom with men of large responsibilities. Reticence is indeed a commendable trait at times, but, unfortunately, if carried to excesss it reacts on the profession. An illustration of this tendency is the unwillingness of a large number of engineers to talk or write for publication. One has only to serve on any of the paper committees of the national societies or to be connected with the technical press to realize the significance of this fact. Only men who have had such opportunities for observation will realize how many excellent ideas have gone to oblivion unrecorded owing to this characteristic trait. Every engineer should record his ideas and conclusions drawn from his experience, at engineering meetings and on any other appropriate occasion, from a sheer sense of duty to the industry of which he is a representative.

The Importance of Storing Coal

IT HAS been only too evident of late that railway transportation is an uncertain factor to rely on for coal supply so far as continuity of service is concerned. Therefore a central station which expects to keep up steady service must be prepared to carry a reserve fuel supply as near to the point of consumption as available space permits. The manner of storage is particularly important. In this issue Prof. H. H. Stoek takes up with considerable detail the deterioration of stored coal. When subjected to alternate wetting and drying, the surface coal crumbles and pulverizes, thus subjecting itself to spontaneous combustion. So far as its heating value is concerned, recent studies on the subject show that there is very little depreciation, and in the cases where the coal can be stored under water, as is sometimes convenient, none at all. The prevailing impression that stored coal burns a little less freely than when it is fresh has no sound basis if the coal is burned in proper furnaces and care is taken not to grub up the earth in handling the coal.

The most noticeable deterioration of coal is generally caused by its heating, even though it does not actually ignite. Where the coal can be kept under water and consequently effectively out of air this danger is eliminated, but if stored on the surface of the ground it is necessary either to give the coal very thorough ventilation or, better, no ventilation at all. Most attempts at ventilation are likely to lead to trouble rather than to avert it.

One common error which Professor Stoek takes pains to contradict is that the locality from which the coal comes has a considerable bearing on success in storing it. Differences in friability and also in the likelihood of heating do exist, but they are of less importance than the size of the coal, the care exercised in its preparation and the manner of storage. If dust and fine coal can be kept out of the pile, it is not likely that the fuel will be heated to the ignition point. If a considerable amount of fine coal exists, however, any ventilation likely to be provided may rather increase the danger, while close packing so as to keep out the circulation of air that induces combustion is preferable. If the coal is clean, screened and of uniform size, loose piling succeeds where it would fail if there were a considerable amount of fine material.

Cost of storage varies enormously on account of the various situations in which piles have to be placed. Figures obtained two years ago show variations from 1.5 cents to 34 cents for storage and from 2 cents to 20 cents per ton for reclaiming. In these days the figures given amount to so small a part of the actual cost of the coal that storage as a provision against the failure of transportation should no longer be put off for this reason.

Complete Analyses of Costs

TOO many industrial establishments which install electrical apparatus of one kind or another for labor-saving or quality-improvement work fail to check operating results in sufficient detail. Haphazard records often baffle the search for economic finality, and in many cases there are no reliable data whatever upon which to judge accurately the "fit" of the installation into its surroundings. Without deprecating the usefulness of honest, painstaking operating information, it must be said that truly complete analyses which include the "overhead" expenses of equipment are a great rarity. Lack of information as to the installation cost doubtless is responsible for this in the vast majority of cases, coupled with the fact that in dealing with depreciation and maintenance it is commonly necessary to make assumptions in order to attain complete figures. A sore need of the electrical industry at the present time is thoroughgoing analyses of installation and operating costs.

Sincere but Misguided

RECENTLY a certain public utility company requested a rate increase from the public service commission of the state and the general manager of the company promptly set about finding out what stand the city officials were going to take in the matter. The city attorney was consulted by the general manager and the case explained to him. As a result the attorney became assured of the reasonableness of the rate increase. He said so openly, even expressing the opinion that the commission was sure to grant the request. The manager of the company then asked him, "And what is your office going to do about the case?" The reply was made immediately, "We shall oppose it." In other words, the city officer was fully convinced of and admitted the fairness of the company's plea, but still sincerely believed it the duty of his office to oppose it. This attitude of antagonism between city and utility company is, to say the least, antiquated and unnecessary. But still it persists widely. We wonder how much longer the public will lend political support to men who thus oppose the real interests of the community. Surely these unreasonable practices will soon become unprofitable also to officialdom.

Henry Marison Byllesby

Engineer and financier—A pioneer in both steam and water-power central-station design.

IN 1881, when the first steam-power central electric station was projected — the famous Pearl Street station in New York—H. M. Byllesby, a young man of twenty-two, was engaged as draftsman and made all of the drawings for the structure and the placing of the equipment. Almost continuously since then he has devoted his energies to the upbuilding of the electrical industry not only in this country but in Canada and Europe as well. He has been an engineer, a manufacturer, a salesman and a central-station executive. In fact, there is almost no phase of the electrical industry which some time in the past forty years has not been enriched by his participation therein.

After two years in charge of building, selling and installing Edison apparatus in Canada, Mr. Byllesby was engaged on his own account in contracting for electric lighting installations. This brought him in 1885 to a turning point in his career, when he became associated with the late George Westinghouse. Shortly afterward the original Westinghouse Electric Company was formed, with Mr. Byllesby as vice-president and general manager. Under his guidance the first commercial alternating-current lighting was introduced. He was active both in the engineering and sales field, remaining with the Westinghouse interests until 1891, the last two years having been spent for the most part in Europe in connection with the development of foreign business. He then became connected with the Thomson-Houston Electric Company as president of the subsidiary handling the Northwest territory.

In 1895 he was again working for himself and during the next seven years he did much of the pioneer hydro-electric work in Montana and northern Minnesota. It was in 1902 that he established the house of H. M. Byllesby & Company, then as an engineering organization. As time went on, however, the functions of the company broadened until now it is probably more widely known for its financial undertakings in the utility, oil and shipping industries and for its management of the numerous utilities under its control.

Mr. Byllesby was born in Pittsburgh, Feb. 16, 1859. He received his preparatory education at the Western University of Pennsylvania. At Lehigh University he studied mechanical engineering, but did not complete his course, leaving at the end of his junior year to work in the laboratory and machine shop of the Weston Dynamo & Electric Machine Company. In recognition of his overseas work, when as lieutenant-colonel he had charge of purchasing in Great Britain and Scandinavian countries for the A. E. F., the British Government awarded him the Distinguished Service medal.

Storage of Coal for Central Stations

The Experience of Recent Years Has Emphasized the Necessity for Storage of Coal—The Coal Should Be of Uniform Size and Free from Dust, but, with Proper Care, Slack and Run of Mine May Be Stored

By H. H. STOEK
Professor of Mining Engineering University of Illinois

ALTHOUGH companies are having difficulty securing sufficient coal for daily needs, to say nothing of building up a reserve, the present situation indicates that many companies would be in a better position if they had larger coal-storage facilities. It is true that money has to be tied up in storage space and coal reserve, but it is quite likely that the fixed charges on this investment would become relatively small compared with the extra price which must be paid for coal in the open market during a shortage. In view of possible future hold-ups in deliveries, congestion of transportation, etc., central stations which do not already have ample coal-storage space might do well to reconsider providing it.

The most troublesome problem in connection with the storage of coal in quantity is the prevention of fires from spontaneous combustion. It is therefore the purpose of this article to discuss experience in storing the usual kinds of bituminous coal with especial reference to fire prevention. Weathering is also considered.

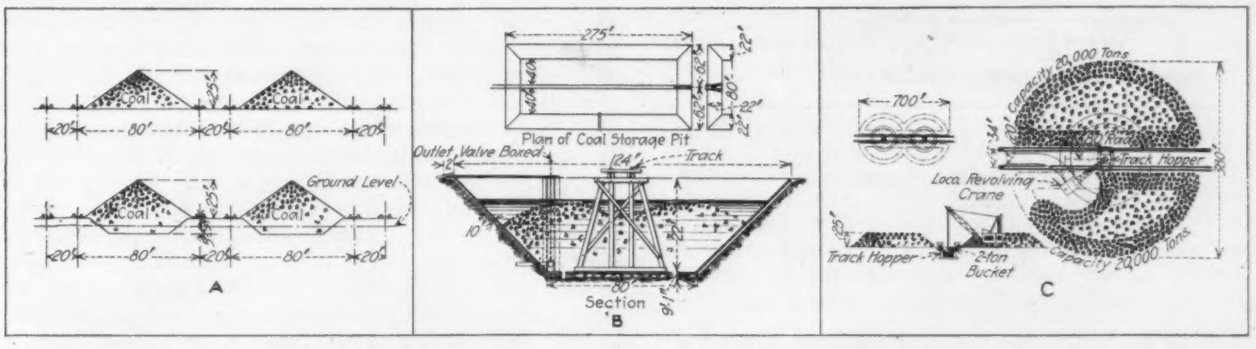
On account of the unequal demands for coal at different seasons of the year, the mines operate irregularly and the demand upon the railroads for hauling the coal is very irregularly distributed throughout the year, the greatest demand upon the railroads being during the fall and winter months, when the equipment is also needed for moving the crops and when the cost of transportation is at a maximum. Equalization of mining and transportation throughout the year help to stabilize other industries and permit of a lower price of coal to the consumer to offset the necessary cost of storage.

Experience has shown that unless mine operating and transporting conditions are rendered more stable the supply of power will continue to reach manufacturing and power plants irregularly, on different days and during different seasons, and, in case of a storm or flood, the supply may be cut off completely for an indefinite period.

That storage is practicable has been demonstrated in all branches of industry, and particularly by the by-product coke companies and other similar industries where continuous operation is necessary. Not only has storage been demonstrated to be practicable in a great variety of industries but in widely separated communities, under greatly different conditions and with great varieties of bituminous coals.

The storage should be as near to the point of actual consumption as is possible and practicable so as to insure to the user a steady supply and to avoid the extra cost and extra breakage incident to each rehandling, and, also, so as best to utilize the transportation facilities. Storage at the point of actual consumption is, of course, frequently out of the question, for in the congested business districts of cities space is too valuable for renting purposes to permit its use for the storing of coal. In such cases storage in any quantity at the point where the fuel is to be used is impracticable.

Many of the large users of coal, however, provide a storage supply on the outskirts of the city or outside the city limits, within range of suburban railroad service or even motor-truck hauling distance. A striking example of this is the Commonwealth Edison Company of Chicago, which, in addition to keeping fair-sized storage piles at each of its power houses within the city limits, keeps a supply of several hundred thousand tons just outside the city limits. Some of this coal has been in storage for about ten years. The supply is kept mostly for emergency purposes and is not drawn on for current uses. Most of the coal is ordinary central Illinois coal from which all coal below 1¼ in. (3.2 cm.) has been removed and used for current consumption. There has been virtually no trouble from spontaneous combustion. During the strike of 1919 this storage supply was reduced to about 15,000 tons.



A FEW TYPICAL METHODS OF STORING COAL IN SUCCESSFUL OPERATION

A—Arrangements of tracks and storage piles employed by the Commonwealth Edison Company. B—Storage pit of Illinois Traction Company at Mackinaw, Ill. C—Circular storage system of Dodge type; a convenient method where ample storage room exists.

Does Coal in Storage Deteriorate?

The effect of storage upon the properties of coal may be considered under the following heads:

Physical Properties.—(1) Appearance; (2) degradation or increase in fine coal.

Chemical Properties.—(1) Loss of heating value; (2) loss in firing qualities; (3) loss in coking and gas making qualities; (4) loss from spontaneous combustion.

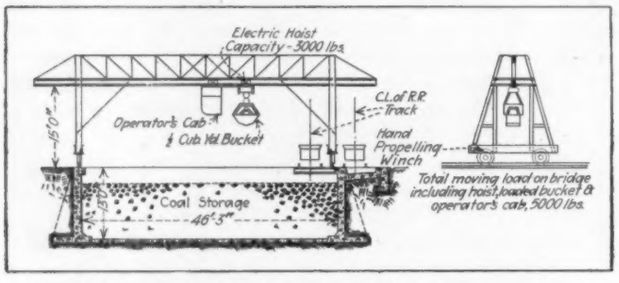
Appearance.—Some coals upon exposure to air

become covered with a coating of white iron sulphate which looks like frost. This simply means that some of the sulphur has oxidized to sulphate, which is usually washed off by rain. This white coating is not found on the coal beneath the surface.

Degradation, or breakage of large lumps into smaller sizes, is due to: (1) Weathering, which causes the lumps to crack and break; (2) handling.

Coal in storage alternately dries out and again absorbs moisture. Pyrite also oxidizes, and both of these causes tend to break the coal. The amount of this weathering depends on the variety of coal, to some extent upon the time in storage, and mainly upon the size of the storage pile. The depth to which weathering extends is not great and any loss due to it is inconsiderable.

Breakage of coal in handling does not materially affect its value for use in central-station plants when stokers are used, but it is of great importance in con-


Electric Hoist
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Total moving load on bridge including hoist, loaded bucket & operator's cab, 5000 lbs.
Coal Storage
46'-3"

UNDER-WATER STORAGE PLANT OF 1,200 TONS CAPACITY, BUILT AT A COST OF $15,300 BY THE WESTERN CLOCK WORKS

nection with spontaneous combustion, as fine coal and dust greatly increase the liability to spontaneous combustion. Such breakage depends entirely upon the appliances used and the care taken in handling the coal.

HEATING VALUE OF COAL NOT GREATLY AFFECTED BY STORAGE

The heating value of coal as expressed in B.t.u. has been shown by Professor Parr[1] at the University of Illinois, by the experiments of the United States Bureau of Mines and by a number of other investigators to be very little decreased by storage and practically not at all with under-water storage.

The opinion is widespread, however, though by no means universally held, that storage coal burns less freely than fresh coal. It must be remembered that sometimes the apparent deterioration is due not to any change in the coal but to the fact that the clamshell or other reclaiming device digs into the soil under the coal pile and mixes soil or refuse with the reclaimed coal. Experiments at the University of Illinois indicate that storage coal may be burned as readily as fresh coal in a stationary plant if a thinner bed is kept and the draft regulated properly.

Coking and Gas-Making Properties.—There are few recorded data concerning the effect of storage upon the coking properties of coal, although the replies to the questionnaires sent out by the writer agree generally in the opinion that heating injures the coal for this purpose. Much of the injurious effect attributed to storage is no doubt due to the heating of the stored coal and is not due to storage *per se*, though the heating is of course an incident that sometimes accompanies storage.

The experiences of the following light, heat and power companies are given in Circular 6, Engineering Experiment Station, University of Illinois, pages 165-169, in too great detail to be quoted here: Rockford Electric Company, Wisconsin Gas & Electric Company, United Railways Company of St. Louis, Aurora, Elgin & Chicago Railway, Union Light & Power Company, St. Louis; Laclede Gas Light Company, St. Louis; Cleveland Illuminating Company, East St. Louis Light & Power Company, and Commonwealth Edison Company, Chicago. The detailed practices of a large number of coke plants, manufacturing concerns, railroads, etc., are also given in the same circular.

PREVENTION OF SPONTANEOUS COMBUSTION

The greatest difficulty in the storage of coal is undoubtedly the tendency of many coals to take fire spontaneously. As previously mentioned, it is the deterioration due to this cause which is often confused with a supposed decrease of heating value as a result of storage.

The gradual heating of a coal pile is due mainly to slow oxidation of the carbon in the coal and, to a less extent, to the oxidation of the sulphur in the iron pyrites contained in the coal. If the air supply is sufficient to permit oxidation but not sufficient to carry away the heat as rapidly as it is formed, the temperature in the pile will rise gradually and finally the coal will take fire. Any method of storage to be successful must be so designed that the heat generated in the pile will not exceed the heat lost by radiation. Freshly mined coal has a special tendency to oxidize and thus to heat. While this property varies with different varieties of coal, it is generally true of all coals. The greater the time elapsing between the mining and storing of any coal, the less is the liability to firing; hence, if possible, coal should be exposed to the air, that is, allowed to become seasoned before it is put in storage. That is, of course, frequently impracticable.

Oxidation of both the carbon and the sulphur takes place more rapidly as the temperature increases; hence coal stored during hot weather is more likely to heat than that stored on cool days. Experience shows that after being in storage three months the liability to heating decreases rapidly.

Space will not permit a more detailed discussion of spontaneous combustion, which can be found in the series of bulletins of the Engineering Experiment Station of the University of Illinois by Prof. S. W. Parr, in the publications of the United States Bureau of Mines and in the publications in Canada by Prof. J. B. Porter.

IMPORTANCE OF SIZE OF COAL IN STORAGE

There is an erroneous, misleading but widespread opinion that the locality from which the coal comes determines whether or not it can be stored. One frequently hears remarks to the effect that eastern coals (meaning those from Pennsylvania and West Virginia) can be easily stored, but Western coals (meaning those from Illinois and Indiana) cannot be, as they are much more liable to spontaneous combustion." Both parts of this statement are too broad, for scientific research and the experience of those storing coal, as shown by the questionnaire sent out by the writer, agree that while there are undoubtedly differences in various coals that affect their liability to spontaneous combustion and

[1] See Circular 6, p. 107, Engineering Experiment Station, University of Illinois, for detailed description and analyses of stored coal.

also their liability to degradation, these differences are of less importance than the size of the coal stored, the care with which it has been prepared and the way in which it is stored.

All varieties of bituminous coal have been stored without spontaneous combustion resulting and it is equally true that all varieties of bituminous coal have fired when stored. This does not mean that all coal stores equally well, as there is undoubtedly a difference in storage quality in coals from different districts and even from mines in the same district. Coals from the same district, however, differ more because of difference in preparation than from inherent liability to spontaneous heating. The kind of coal that is to be stored should be inquired into, and coals that are known to be particularly liable to spontaneous combustion should not be selected for storage if it is possible to avoid doing so.

There are not sufficient data available at this time to classify coals as to their liability to spontaneous combustion, and it is doubtful if this ever can be done, because liability to spontaneous combustion does not seem to be an inherent quality of the coal from any given seam, district or mine, but seems to depend more upon the size of the coal, its freedom from dust, to a less extent the amount of pyrite (sulphur) present, and to a very great extent upon the way in which it is piled.

The spontaneous combustion of the coal is due largely to the oxidation of the fine coal and dust and the confining of the resulting heat; consequently the liability to spontaneous combustion in stored coal is greatly reduced and in many cases eliminated:

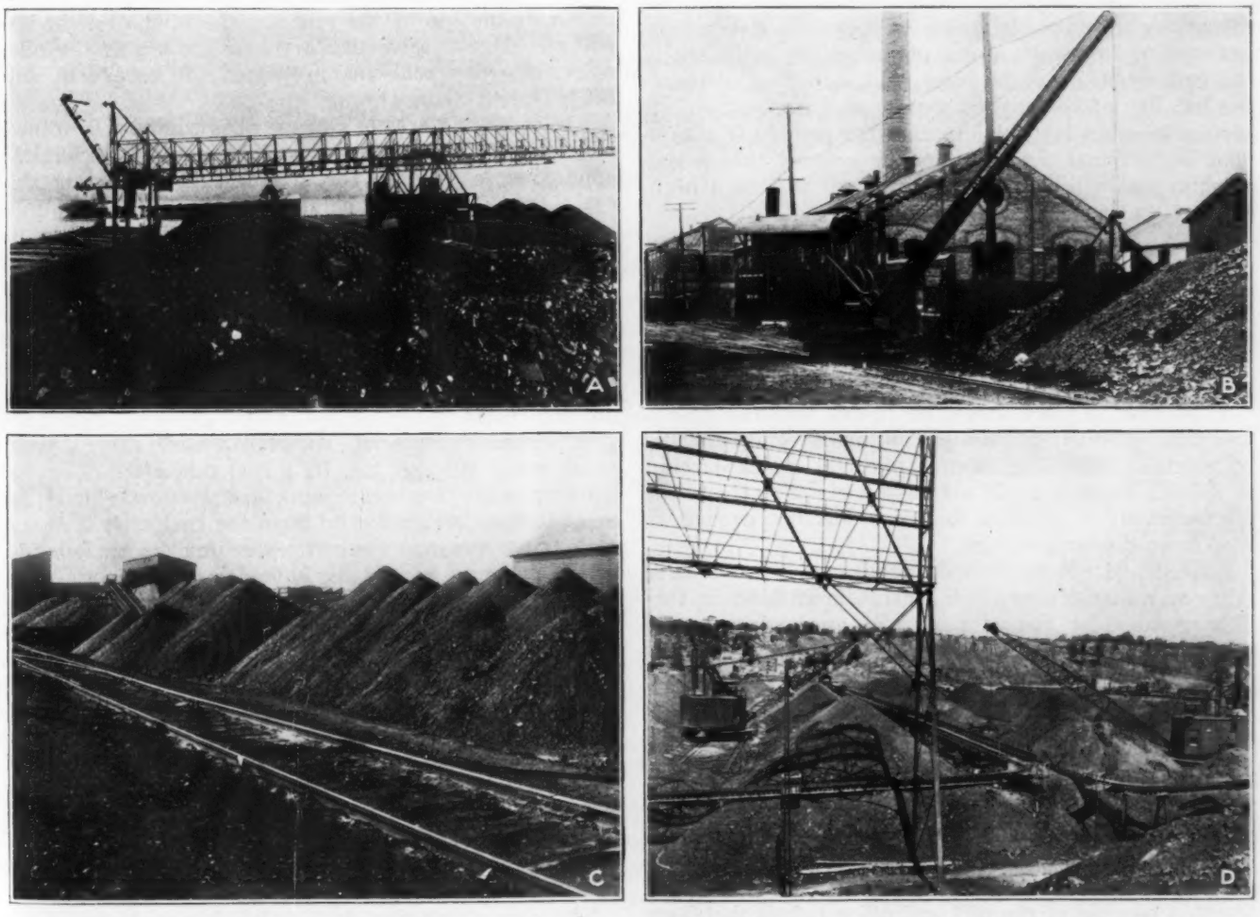
(1) If dust and fine coal can be kept out of the pile.

(2) If the coal is of such size and so piled that there is a sufficient air current throughout the pile to carry off the heat due to the oxidation that goes on, so that the coal is not heated at any spot to the ignition point.

(3) If the coal is so closely packed that sufficient air cannot come in contact with the fine coal to cause oxidation.

It should not be forgotten that for every case of spontaneous combustion in a coal pile many instances can be cited where no heating has occurred in the same coal. Even if the coal heats slightly, this can be detected readily and the coal moved and cooled off. Clean, screened coal of a uniform size should be chosen, if possible. The larger and more uniform the lumps the better, so as to give an open-textured pile. Coal of one size is, therefore, better than a mixture of sizes. Sized coal should not be stored upon a foundation of fine coal.

The coal should be handled in such a way as to prevent breakage as much as possible. If there is a choice of coals for storage, the least friable should be chosen and the one in which there is the least fine material. Breakage not only produces dust, but the fresh surfaces of coal oxidize more readily than the weathered ones. Coal should not be dropped upon a pile from a height, but the bucket or other receptacle should be lowered to the pile before being dumped.



COAL SHOULD BE SIZED FOR STORAGE WHERE POSSIBLE AND PROVIDED WITH ADEQUATE HANDLING ARRANGEMENTS

A—Conveyor bridges for handling coal in storage, Coal Dock & Wharf Company, Duluth, Minn. B—Storage for small power plant. C—Coal piled for storage by clamshell at the District of Columbia storage yard. D—Two circular storage locomotive cranes in operation at the coal storage plant of the New York Edison Company, Shadyside, N. J.

In every case of a fire in so-called lump coal investigated by the writer it was found that the coal had been dropped through a considerable height, so that coal on the pile was far from being lump coal and contained a large amount of dust.

How to Store Run-of-Mine and Slack Coal

While many varieties of mine-run coal cannot be stored under ordinary conditions because of the presence of fine coal and dust, such coal has been successfully stored in small, low piles. In storing mine-run coal it should be piled in uniform layers and segregation of the sizes prevented. The piles should be as low as space will permit, carefully watched, and provision made to quickly move the coal if heating occurs.

In general, fine coal or slack is more liable to spontaneous combustion than clean sized coal, or usually than run-of mine. If stored, it should be very carefully watched to detect evidence of heating. If practicable, a slack pile should be rolled with a roller so as to exclude the air and to give as nearly as possible storage under water conditions. Fine clean coal and slack have been successfully stored, particularly where closely packed, but the only absolutely safe way of storing slack is under water.

Although experimentation has shown that the sulphur contained in the coal in the form of pyrite is not the chief cause of spontaneous combustion, as was formerly supposed, the oxidation of the sulphur in the coal not only produces heat but also assists in breaking up the lumps and thus increases the amount of fine coal in the pile. Any considerable rise in temperature either from external or internal sources promotes the oxidation of the iron pyrites and produces heat, and thus increases the liability of the coal to spontaneous combustion. It is wise to select low sulphur coals for storage if obtainable, but it must not be taken for granted that a low-sulphur coal will necessarily store well or that a high-sulphur coal will fire in storage.

Precautions to Be Taken in Storing Coal

It seems to make little difference in the liability to spontaneous combustion whether the coal is stored under cover or in the open, but under cover there is less degradation and weathering. Storage under cover is of course impracticable for large amounts.

If possible, a place should be chosen that is dry and well drained, or, if not drained naturally, drains should be provided about the storage pile, not underneath it, as a drain beneath a pile may admit air currents to the pile sufficient to produce oxidation but not enough to keep down the temperature.

Coal should not be dumped on ground covered with ashes or refuse of any kind, because in addition to furnishing flues for the admission of an inadequate air supply to the coal pile, such refuse often contains material that will assist spontaneous combustion. Furthermore, it is likely to become mixed with the coal and when it is reclaimed from storage the value of the coal is thus depreciated. If possible, the ground should be clear of vegetation and leveled off, so that the reclaiming of the coal may be done as easily as possible and so that dirt and refuse will not be taken up by the shovel or other devices used in reclaiming. Some of the objections of firemen to using coal that has been stored are justified because of the dirt and other refuse that have been mixed with the coal in taking it from the storage pile. A hard-clay bottom thoroughly drained is desirable, if a concrete floor is too expensive.

If possible, adequate space should be provided so that the coal can be moved to another place if heating occurs.

Coal should not be piled around hot pipes, against a boiler or hot walls, around a chimney, or in any place where it will be subjected to outside heat, because the liability to spontaneous combustion increases rapidly with a rise in temperature.

Coal should not be stored above flues that will permit small amounts of air to enter the coal; hot air, such as that from a sewer, is particularly to be avoided.

Method of Piling Is Important

Coal should be so piled for storage that any part of the pile can be moved promptly if necessary.

Coal should either be so piled that air may circulate freely through it and thus carry off any heat generated in the pile by oxidation, or else it should be so closely packed that air cannot enter the pile; *i.e.*, approximate as nearly as possible under-water conditions. Slack has been successfully placed in storage by rolling it or by running a heavy truck over the pile.

Stratification, or the segregation of the fine and lump coal into layers, should be avoided, since an open stratum of coarse lumps provides a passage for air to reach and oxidize the fine coal, and the stratum of fine coal does not permit the heated air to pass off rapidly enough to keep down the temperature of the pile below the combustion temperature.

Coal should not be dumped at one point at the top of a conical pile, since then the fine coal stays in the center at the top of the pile and the lumps roll to the bottom. Many coal fires start near the top of the pile, where the fine coal has prevented the escape of the heated gases rising through the pile.

The depth and area of storage piles will be determined largely by the storage space available and the mechanical appliances to be used for storing and reclaiming the coal. Other conditions being equal, the deeper the pile and the greater the area, the greater the difficulty in inspecting it and moving it quickly, if necessary. Hence a number of small piles, if practicable, are better than one large pile. Lack of space, however, usually prevents such spreading out of coal. It is impossible to advise exact heights, as so much depends upon the kind and size of coal and the local conditions, but the lower the pile the better.

Inflammable material, such as waste, paper, rags, wood, rosin, oil and tar, in a coal pile often forms a starting point for a fire, and every effort should be made to keep such material from the coal as it is being placed in storage. Timbers extending to the outside of the pile may permit the entrance of air around the pile. The admission of air into a coal pile around the legs of a trestle, through a porous bottom such as coarse cinders, or through cracks between boards, etc., should be avoided. Coal should not be piled about timber posts.

The effect of ventilating coal piles is a disputed point, but the weight of evidence in the United States seems to be against the practice. This may possibly be due to the fact that ventilation has been inadequately done. Imperfect ventilation, such as that generally attempted in the United States, is certainly disadvantageous. Reports from Canadian practice favor ventilation by pipes placed close together in the coal pile.

The cost of storing and reclaiming coal should be included under the following heads: Overhead, labor, supplies, depreciation on mechanical equipment, interest on investment, rental on land on which coal is stored,

insurance on equipment, and insurance on coal. Very few if any costs thus itemized are available, and most of those furnished in response to questionnaires include labor only and sometimes supplies.

Costs collected in 1917-18 showed a variation for storage of from 1.5 cents to 34 cents per ton for storage and 2 cents to 20 cents per ton for reclaiming and a total variation for storing and reclaiming of from 4 cents to 54 cents. The cost for storage and reclaiming by steam shovel or locomotive crane averages from 10 cents to 20 cents for labor and materials. The detailed costs for 1917-18 for a number of plants will be found in Circular 6. An attempt has been made to get present construction and operating costs from the same and other companies, but the replies received have not been very complete, and the costs reported vary as compared with those in 1917 up to as much as 100 per cent more.*

The methods of storing coal may be included under the following general headings: Hand-operated—wheelbarrows, etc.; motor trucks; side hill without a trestle; trestle storage; locomotive crane storage; circular storage; combined trestle and crane system; mast and gaff; steeple towers; movable bridges; buckets moving on monorail or cableway; silo storage; conveyor belts; portable and semi-portable conveyors; under-water storage. Space will not permit a discussion of each of these types, but detailed and illustrated descriptions will be found in Circular 6 and Bulletin 116.

In conclusion, it may be stated that it has been conclusively demonstrated by utility companies, using coal in both large and small amounts and under a great variety of conditions, that bituminous coal which has been properly prepared and properly piled can be stored with very little danger from loss due to spontaneous combustion, provided that the pile is carefully watched and appliances are provided for getting at a point where heating may develop so as promptly to spread out the coal that it may cool. If coal is stored in a haphazard method, as is usually done, spontaneous combustion frequently occurs.

For a central power station continuous operation is of more importance even than for a single plant, and the insurance of an adequate coal supply at all times is very necessary. Hence coal storage for such a plant must be considered as necessary insurance. Experience has shown that any kind of coal may be stored if properly prepared and piled.

*See *Mining and Metallurgy*, March, 1920, for costs presented by writer at annual meeting of American Institute of Mining and Metallurgical Engineers.

Water-Power Development in Canada

Total Potential Water Power About 20,000,000 Hp., of Which Only 2,418,000 Hp. Is Developed, 72 per Cent in Central Stations

THE Dominion Water Power Branch, Department of the Interior, and the Dominion Bureau of Statistics, Department of Trade and Commerce, have through cooperation just completed an exhaustive census and analysis of the developed water power in Canada. The figures, which are complete to Jan. 1, 1920, are exceptionally interesting and are indicative of the marked manner in which the water-power resources of the Dominion are being put to advantageous use. Practically every great industrial center in Canada is now served with hydro-electric energy and has within easy transmission distance ample reserves of water power. Active construction in hydro-electric enterprise is fast linking up the few centers which are still unserved and which have water-power resources in their vicinity. In those localities where water power is not available there are fuel reserves of coal, gas or oil.

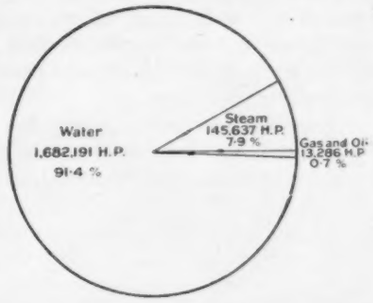
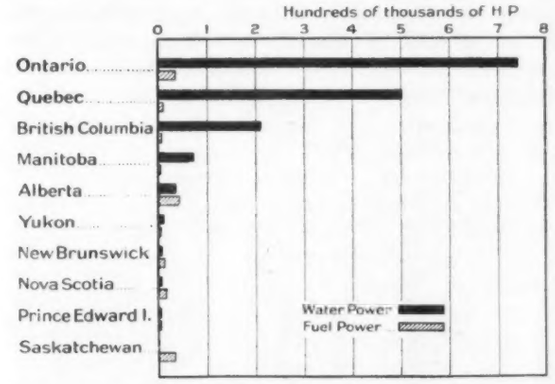


FIG. 1—PRIMARY POWER OF CENTRAL STATIONS, NOT INCLUDING AUXILIARY FUEL PLANTS

According to a recent computation the water-power resources of the British Empire have been placed at from 50,000,000 hp. to 70,000,000 hp. This does not include such territories formerly under control of the Central Powers as will fall in future under British influence. To this total Canada contributes in the neighborhood of 20,000,000 hp. This figure represents the power available at sites at which more or less definite information is to hand. Continued investigation will undoubtedly add to this figure.

According to the statistics just compiled, there is installed throughout the Dominion some 2,418,000 turbine or waterwheel horsepower (Table I), of which 2,215,000 hp. is actually and regularly employed in useful work. The larger figure includes the total installed



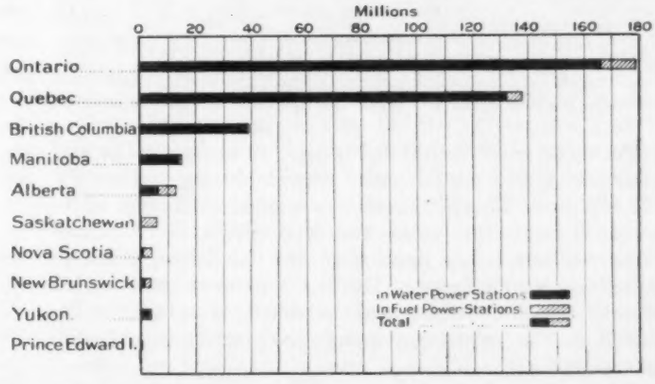


FIG. 2 (AT LEFT) — WATER VERSUS FUEL POWER, NOT INCLUDING PRIMARY POWER EQUIPMENT OF AUXILIARY POWER PLANTS.
FIG. 3 (AT RIGHT) — CAPITAL INVESTED, BY PROVINCES, 1918

capacity at full gate, including reserve units. It does not, however, include hydraulic exciter units. A large number of the plants now operating are designed for the addition of further units as the market demands. The ultimate capacity of such plants and that of new plants now under construction totals about 3,385,000 hp.

Of the total power installed, 1,756,791 hp., or 72.7 per cent, is installed in central electric stations. Central-station power is sold for lighting, mining, electrochemical and electrometallurgical industry, milling and general manufacturing. It is apparent, therefore, that the central-station total listed in column 3 includes a portion of the totals listed in columns 4 and 5 as used in other industries. In the pulp and paper industry 473,265 hp. is utilized, of which 381,631 hp. is generated directly from water in pulp and paper establishments, while 91,634 hp. is purchased from hydro-electric stations.

Hydro-electric power used for other purposes and other industries may be listed as follows: For lighting purposes, 434,613 hp.; in mining industry, 177,728 hp.;

TABLE I—DISTRIBUTION OF DEVELOPED WATER POWER IN CANADA

	Developed Water Power					
	Total Waterwheel and Turbine Horsepower Installed	Total Waterwheel and Turbine Horsepower Installed for Use in			Total Horsepower Actually Employed	Ultimate Capacity, Horsepower
		Central Electric Stations	Pulp and Paper Industry	Other Manufacturing Industries		
Yukon	13,199	10,000	.....	.....	11,349	13,199
British Columbia	308,167	211,043	46,962	46,094	276,795	350,832
Alberta	32,992	32,580	.....	17	31,754	33,070
Saskatchewan	.....	.....	.....	.....	.....	.....
Manitoba	83,447	71,790	.....	.....	75,100	297,047
Ontario	1,015,726	794,621	158,095	99,230	934,015	1,460,920
Quebec	910,029	623,088	249,332	270,961	838,071	1,146,465
New Brunswick	18,080	9,378	2,693	6,009	16,657	29,115
Nova Scotia	34,323	4,064	16,183	12,276	29,359	52,202
Prince Edward Island	1,933	227	.....	1,789	1,621	1,958
Totals	2,417,896	1,756,791	473,265	436,376	2,214,721	3,384,808

Ultimate designed capacity of plants now operating or under construction in hp.

in flour and grist mills, 42,736 hp.; in lumber mills and sawmills, 37,918 hp.; in other manufacturing industries, 172,955 hp. These figures are evidence of the widespread manner in which the Dominion's water-power resources are being applied to the furtherance of its industrial development. During the fiscal year ended March 31, 1919, there was exported from plants included in the tabulation energy amounting to 175,000 hp.-years.

Table II, analyzing the number and capacity of the waterwheels and turbines installed, is of considerable interest. The total installation of 2,417,896 hp. is composed of 3,370 units of an average capacity of 715 hp. While 2,244 of these units are of 100 hp. or under, they contribute only 82,204 hp., or 3.4 per cent, to the total. A total of 1,845,427 hp., or 76.3 per cent of the whole, is contributed by units of 2,000 hp. and over; 1,391,025 hp., or 57.6 per cent, by units of 5,000 hp. and over; 1,029,900 hp., or 42.6 per cent, by units of 10,000 hp. and over, and 160,000 hp., or 6.6 per cent, by units of 20,000 hp. and over. This table is illustrative of the modern tendency toward the installation of large units.

The statistics in Table III refer to the developed water power used in connection with the central-station industry. This industry has made great strides in Canada in recent years. A network of transmission systems, which are being rapidly extended from year to year, covers central and southwestern Ontario and southern Quebec. Other systems established in numerous centers from coast to coast are likewise rapidly extending their scope. Ninety-one and four-tenths per cent of the primary power used in the central stations throughout the Dominion is derived from water, evi-

TABLE II—TURBINES AND WATERWHEELS INSTALLED IN WATER-POWER PLANTS

	Total Water-Wheels and Turbines	Units of 2,000 Hp. and Under 5,000 Hp.		Units of 5,000 Hp. and Under 10,000 Hp.		Units of 10,000 Hp. and Under 20,000 Hp.		Units of 20,000 Hp. and Over	
	Hp.	No.	Hp.	No.	Hp.	No.	Hp.	No.	Hp.
Yukon	13,199	..	.....	2	10,000	..	.....	..	.....
Brit. Columbia	308,167	19	62,100	6	42,000	12	144,600	..	.....
Alberta	32,992	2	8,000	4	23,600	..	.....	..	.....
Saskatchewan	.....	..	.....	..	.....	..	.....	..	.....
Manitoba	83,447	9	35,597	8	46,400	..	.....	..	.....
Ontario	1,015,726	77	186,380	14	88,050	36	474,200	2	40,000
Quebec	910,029	51	157,825	22	151,075	20	251,100	6	120,000
New Brunswick	18,080	1	2,000	..	.....	..	.....	..	.....
Nova Scotia	34,323	1	2,500	..	.....	..	.....	..	.....
Prince Edward Island	1,933	..	.....	..	.....	..	.....	..	.....
Totals	2,417,896	160	454,402	56	361,125	68	869,900	8	160,000

dencing in a striking manner the advantageous location of the water-power resources with regard to industrial centers.

The total installed waterwheel and turbine horsepower in hydro-electric stations is 1,756,791 hp. Fuel auxiliaries to these stations bring the total installed primary capacity up to 1,873,989 hp., connected to a dynamo capacity of 1,449,180 kva. The total capital invested in these central stations, inclusive of transmission and distribution systems, is $369,461,961, or an average of $210 per installed primary horsepower.

Of special interest to engineers is the actual cost of construction of hydro-electric power stations, exclusive of transmission and distribution systems. The figures of seventy representative hydro-electric stations throughout the Dominion, with an aggregate turbine installation of 745,797 hp., show a total construction

TABLE III—CENTRAL ELECTRIC STATIONS OPERATED BY WATER-POWER

	Installed Horsepower				Capital Invested	
	Water-wheels and Turbines	Fuel Auxiliaries	Total	Total Installed Dynamo Capacity in Kva.	Total	Per Horsepower
Yukon	10,000	.....	10,000	6,000	3,471,678	347
British Columbia	211,043	26,780	237,823	154,571	38,450,131	182
Alberta	32,580	2,405	34,985	24,260	6,990,972	214
Saskatchewan	.....	.....	.....	.....	.....	.....
Manitoba	71,790	19,400	91,190	62,313	14,340,458	200
Ontario	794,621	39,530	834,151	670,053	170,112,988	215
Quebec	623,088	28,163	651,251	522,461	133,645,655	214
New Brunswick	9,378	500	9,878	6,160	1,543,727	165
Nova Scotia	4,064	420	4,484	3,016	842,122	207
Prince Edward Island	227	.....	227	346	67,230	296
Totals	1,756,791	117,198	1,873,989	1,449,180	369,464,961	210

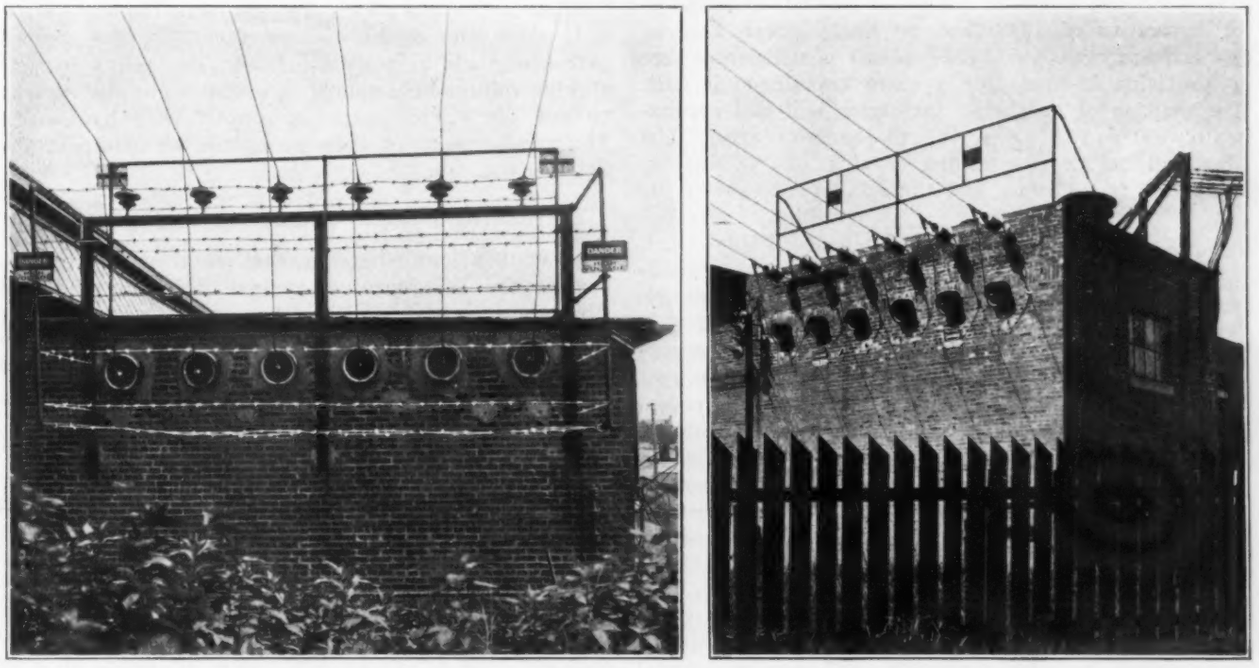
cost of $50,740,468 (pre-war figures), or an average of $69.11 per installed horsepower. This cost includes the capital invested in construction of dams, flumes, penstocks and all hydraulic works and of power stations and equipment. It excludes real estate and transmission and distribution equipment. The figures in brief show capital cost of construction at the power site.

With a water-power development of 274 hp. per thousand population, Canada stands well in the forefront in respect to availability and utilization of hydro-power resources, being surpassed in this respect only by Norway. The enormous water-power reserves still untouched are an assurance of continued industrial expansion and prosperity.

Substations for Supplying Large Industries

Factors to Be Considered in Design and Installation — Typical Substations Vary in Cost from $11.36 to $38.68 per Kva. of Installed Capacity — Simplicity in Arrangement and Wiring Is Important

By R. H. TILLMAN
Consolidated Gas, Electric Light & Power Company, Baltimore



TWO TYPICAL 13,200-VOLT OVERHEAD ENTRANCES, SHOWING METHOD OF INCREASING SAFETY OF INSTALLATION

FOR an industrial substation to perform its function well consideration must be given to transformation, metering, protection and control requirements, with particular reference to simplicity in arrangement of equipment, wiring and neatness in appearance. The transforming equipment is the most expensive part of the station, and since it is the portion that does the work, it should be considered most carefully. Sufficient metering equipment should be installed to measure the actual energy consumed and the amount of demand in kilowatts and kilovolt-amperes. Protection of the equipment from lightning disturbances, line surges and overloads should receive the best of engineering thought. Control in an industrial substation does not usually play so important a part as it does in the large utility companies' substations, but nevertheless the location of switches should be such that control of the various circuits can be easily and quickly accomplished and that certain parts or the whole of the station can be disconnected to take care of repairs in case of emergency. These factors and others will be considered in detail in this article.

Locating the Substation

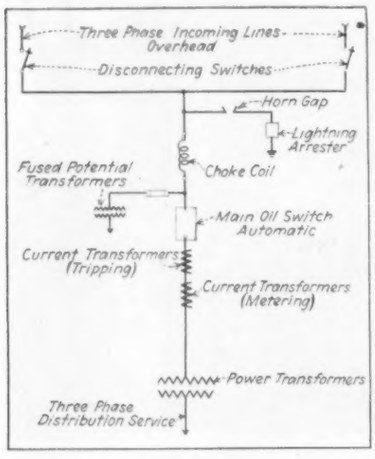
An industrial substation should be located as near as possible to its heaviest load, or near the center of distribution, taking into consideration the possibilities of this position changing with the growth in the industry's business. The station may be placed in a separate building, in one corner of one of the manufacturing buildings, or, where the plant is outside of the city limits, it may be installed as an outdoor substation. The way of access should never be blocked, since materials and apparatus must be carried to and from the substation in making repairs and extensions. The question of future extensions to the substation and the direction of growth of an industrial load deserves thorough consideration. Many stations are made useless after a year or so by the failure to consider these points. Experience shows that industries are constantly increasing their loads as their business grows, and therefore stations should be so designed and located that future increases can be easily made with the least interruption to manufacturing operations. This is especially true with a new industry. Owing to rapid increase in industrial business it often happens that an entire substation first considered permanent must be changed and relocated, the removal causing great expense. Cleanliness and ventilation, which are both required in substations, should also affect the choice of a site.

All buildings used for substations should be constructed of some approved fireproof material, such as brick, stone, concrete, tile or corrugated galvanized steel, with concrete floor. This floor should be at least 6 in. (15 cm.) in thickness and should be drained at a suitable point to the sewer. Provision should also be made for suitable ventilation through one or more sides and the roof. Louvers placed in the side walls close to the ground have been found to be a very effective means of ventilation. Where it is to be used for rotary converters and motor-generator sets in addi-

tion to transformers, a suitable air duct should be placed in the floor, starting from the outside wall of the building and terminating in the pit under the rotary converter or motor-generator set.

Space should be allowed for making repairs, and the distances between the various pieces of apparatus should be such that the largest pieces can be readily removed, and the door should be large enough to allow an easy entrance for all machines.

With the usual type of industrial substation buildings for capacities of 1,500 kw. or less, a floor area of approximately 300 sq.ft. (27.6 sq.m.) is sufficient where no provision is made for a spare transforming unit. The addition of another transformer will add approximately 50 sq.ft. (4.6 sq.m.) to the floor area. The usual height for substations of this size is approximately 15 ft. (4.5 m.), and the cubical contents of the building averages about 4,500 cu.ft. (126 cu.m.), considering the inside dimensions only.



THIS WIRING DIAGRAM SHOWS RELATIVE POSITIONS OF EQUIPMENT NECESSARY IN INDUSTRIAL SUBSTATION

A—A compact arrangement of oil and disconnecting switches, choke coils, lightning arresters and the metering installation. B—Wiring on the ceiling and walls lends itself to a simple and neat installation if the work is properly done. C—Pipe work for supporting the high-tension wiring offers a good arrangement.

Owing to the rapidly increasing cost of electrical equipment and building construction during the last few years, it is next to impossible to give any definite idea as to unit cost in connection with substations. However, the tabulation will give a general idea as to the present cost. It can be considered that a substation for a normal transformer installation of 1,000 kva. capacity would require a building of 300 sq.ft. floor area, with a height of 15 ft. and with cubical contents of 4,500 cu.ft., and would cost approximately $1,500. The transformers, installed complete, would cost approximately $15,000, or the total cost of the transformer station ready for operation may be estimated at $16,500.

In the last few years the use of outdoor substations has rapidly increased, largely because of efforts on the part of large hydro-electric utility companies to reach rural communities from their high-tension transmission lines, and also because of the lower first cost of installation. In most cases, therefore, outside of large city limits, the outdoor substation would naturally be adopted, except where the atmospheric conditions such as acid and gas fumes or dust would make an outdoor substation inadvisable. However, there are many conditions to be considered besides the first cost of installation in connection with industrial substations, and as previously mentioned, reliability of service is of prime importance and repairs and maintenance should not be forgotten.

Where the industry is within the city limits, and where circumstances such as the character of property surrounding the station require it, underground service is usually adopted. In these cases the service cables are pulled through the duct line up the wall in tile duct, terminating in a standard pothead at least 6 ft. (1.5 m.) from the floor, or in such a position that persons cannot come into contact with the high voltage. The various pieces of apparatus in the station should be so arranged that a straight-away feed can be used—that is, a service entrance in one end of the building and a straight feed directly through the opposite end.

Where industrial plants are outside of the city limits, and where the conditions are favorable, the service entrance should be made overhead. For safety reasons all high-voltage lines should be properly guarded so that no one can readily come in contact with live wires. The arrangements of these entrances are shown in the illustrations.

IMPORTANT DETAILS OF SUBSTATION EQUIPMENT

In installations where overhead entrances are used devices for safeguarding against lightning and line surges should be installed, depending, however, on the voltage. The equipment usually consists of aluminum lightning arresters and choke coils and should be installed inside or outside of the substation as close as possible to the service entrance.

Disconnecting switches of the spring-lock, knife-blade type, installed immediately after the service entrance, are usually placed at such a height from the floor that contact with live parts would be impossible. The switches should be opened and closed only with a hook attached to a long wooden pole. To insure against damage to the transformers due to overloads, automatic oil switches arranged for either hand or electric operation should be installed. The type and capacity of these oil switches will depend upon the voltage and amount of energy to be delivered, as well as on the reactance of the circuit. For the automatic control of these switches reverse-time-element relays should be used, and where several switches are installed in the station the relays should be set for selective action.

As all industrial substations should be as nearly foolproof as possible, it is evident that oil-insulated, self-cooled transformers should be used for this work, and the specifications for such transformers should include the following: Type of transformer; normal full-load rating, giving the normal voltage both primary and secondary; additional primary and secondary voltages and taps; the conditions under which the transformers must operate, as to number in group, type of connection, voltage and phase to transform; exciting current of transformer; position of terminals on transformers.

Lighting transformers are necessary in industrial substations having a secondary voltage of more than 230, unless taps are placed in the secondary windings of the power transformers.

Special transformers wound for a primary voltage the same as the primary voltage of power transformers have the advantage, when a separate oil switch is used for their control, that the lighting installation is operated without the power transformer bank being used at the same time. The use of additional taps on the secondary windings of the power transformer is also a method of handling lighting but involves an additional cost, and some unbalancing will result.

By using a special transformer wound for a primary voltage the same as a secondary voltage of the power

PRESENT-DAY COSTS FOR INDUSTRIAL-TYPE SUBSTATIONS

Kva. Rating	Primary Voltage	Frequency	Secondary Voltage	Character of Secondary Voltage	Reasons for Using Direct Current	Area of Station, Sq.Ft.	Approximate Cost in 1920 — Total Cost of Station Excluding Building	Cost per Kva.	Cost of Station Building	Remarks
300	4,000	60	230/115	3-phase		...	$4,900.00	$16.33	.....	
600	13,200	25	575	3-phase		272	8,114.00	13.52	.....	
600	13,200	25	575	3-phase		298	9,316.00	15.52	.....	
1,200	13,200	25	575	3-phase		490	17,117.64	14.26	.....	
900	13,200	25	575	3-phase		270	12,587.30	13.98	.....	
500	13,200	25	125/250	D.C.	Electrolytic	...	19,340.00	38.68	.....	Old building
950	13,200	25	460	3-phase		360	10,800.00	11.36	$1,760.60	Change in old building for station
750	13,200	25	230	3-phase		360	12,548.66	16.73	1,930.50	Station includes elaborate secondary switchboard
750	13,200	25	460	3-phase		189	10,730.62	14.30	.....	Used old building
300	13,200	25	550	3-phase		180	6,164.00	20.54	1,630.00	
300	4,000	60	230	3-phase		494	4,055.58	13.51	2,374.90	Extra large building

transformers the cheapest method of installation is possible. While this method has the disadvantage of requiring that power transformers be connected to the line at all times when lights are in use, still in the majority of industrial plants it would not cause a serious loss in energy, owing to the fact that usually some power machinery is operated twenty-four hours a day.

CAREFUL ATTENTION SHOULD BE GIVEN METERING EQUIPMENT

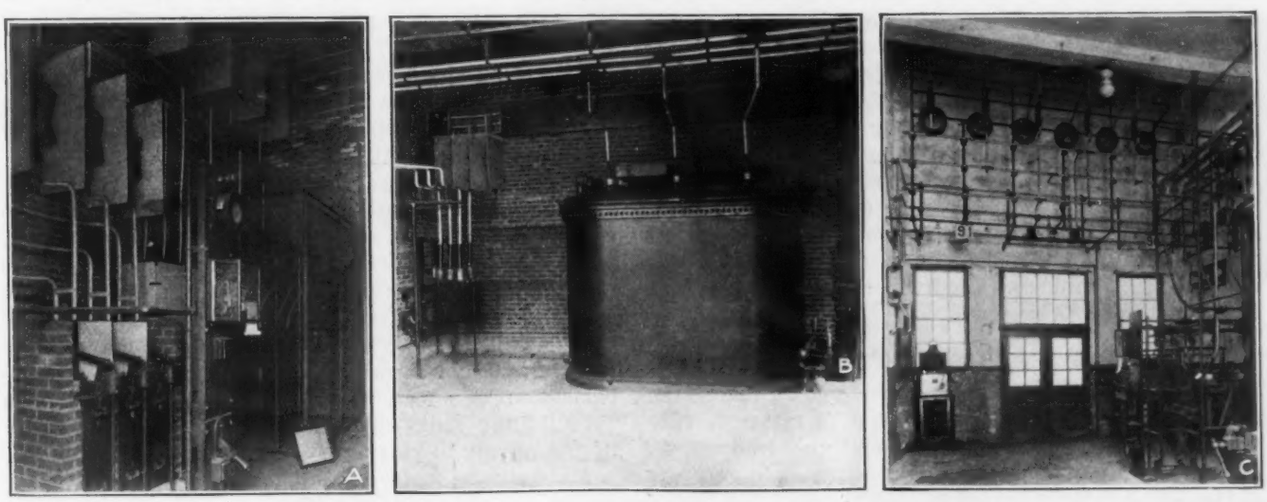
As it is almost a universal practice of the public utility companies to have their rate schedules based on a maximum-demand charge as well as an energy consumption charge, it is essential that both the watt-hour meter and a demand-measuring device be installed and that the potential transformer fuses be of a size to afford sufficient strength mechanically. For convenience of both the industry and the public utility company it is recognized that a recording watt-meter that will record continuously the energy demanded by the industry day by day throughout the year is the proper method of measurement so far as the maximum demand is concerned. Therefore provision should be made in the industrial substation for the public utility company's integrating watt-hour meter and one graphic wattmeter. Most public utility companies have a power-factor clause in their schedules of rates, so in addition to the above meters, a reactive volt-ampere indicator for the registration of power factor would be required.

Finally, since among the arguments that utility companies employ in selling electrical energy to manufacturing industries is that with central-station service the manufacturer is free from worry, the industrial substation must be so designed that simplicity is one of its features. No apparatus should be installed that does not carry with it the feeling of absolute reliability.

Water-Power Development in Austria

AN APPROPRIATION of 95,000,000 Austrian crowns has been made available for beginning the electrification of the government railroads of Austria. Construction work has been started, this including the erection of a hydro-electric power plant on Lake Spuller, in the western part of the Tyrol, which will probably be completed by the end of 1921, and other plants in Salzburg and Carinthia in the latter part of 1923.

The *Neue Freie Presse* of Vienna, which prints this information, also states that progress has recently been made in supplying Vienna with electric power by the utilization of the Danube River. It is hoped that by the end of the year work will be started on a plant capable of furnishing 30,000 hp. even in the first stage of construction. Opposition to proposals from Vienna to co-operate in this development has arisen in Styria, which has a hydro-electric power plant on the Enns River but refuses to sell any of its output to the Austrian capital, insisting on a policy of "Styrian hydraulic power for the Styrians." This separatist spirit among the different communities of Austria has a retarding effect on water-power development, which is accentuated by the absence of foreign capital. However, Linz, in upper Austria, is actually engaged in preliminary construction work, and the plans of Vienna have taken definite shape, involving, in addition to the Danube River plant, installations in the Ybbs Valley and on the Alpine springs conduit in Gaming.



EXAMPLES OF NEAT AND WORKMANLIKE INDUSTRIAL SUBSTATION INSTALLATIONS

Selection and Design of Exciter System

Factors Which Determine the Selection of an Excitation System for a Generating Plant Are Comprehensively Discussed in A. I. E. E. Paper—Considerations of Layout After General System Has Been Decided Upon

FOR the purpose of discussing, in a broad way, the characteristics of excitation systems, J. T. Barron and Alex. E. Bauhan have considered them in four groups: A—central systems with separately driven exciters; B—central systems with direct-connected exciters; C—individual systems with direct-connected exciters; D—individual systems with separately driven exciters. These four systems are compared from every important angle, and then problems of design of the system are taken up for the purpose of calling attention to the advantages and limitations of common layout schemes and types of apparatus.

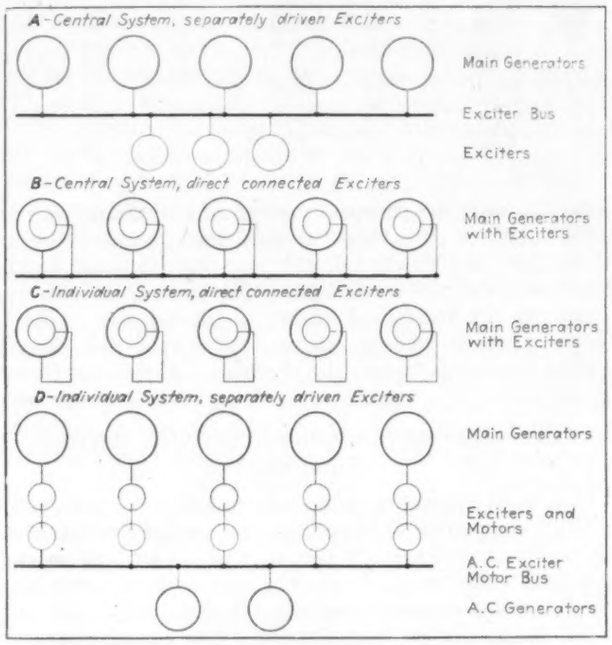
A very comprehensive table has been prepared by the authors in making the comparison between systems. This table is here printed in full.

The practice of using the excitation system to supply auxiliaries is common in hydro-electric plants but is not the general practice in steam plants. It is not within the scope of the paper to discuss the merits of the different methods of driving auxiliaries, but if it is decided that some of the auxiliaries must be fed by the excitation system the choice of system is affected. If the exciters are controlled by a voltage regulator, it is not advisable to supply any auxiliaries from the excitation bus. It must be remembered that high voltages may be induced in the field circuits from main system troubles or by the loss of exciter supply, and if provision is not made against this the high voltage may affect auxiliaries at least to the extent of blowing fuses. System D offers a good source of power for auxiliaries. If the individual exciters are driven by induction motors at low voltage, the auxiliaries can be driven from the same bus as the exciter motors.

Regarding voltage regulation, where exciters are to be controlled by voltage regulators it should be borne in mind that they should be especially designed for this purpose. The special features usually consist of providing for low saturation and for ample range without going too far above the knee of the saturation curve. In systems A and B voltage regulation can be obtained by the use of one voltage regulator of either alternating-current or direct-current type or of the alternating-current coil type operating on the field rheostats of all the exciters. In the case of systems C and D, however, if the alternating-current and direct-current coil type of regulator is used, a separate regulator is usually used on each exciter. Each of these regulators must be equipped with a current connection which receives a current proportional to the generator current and at ninety degrees to the potential in the alternating-current coil in order to stabilize reactive component distribution.

Correct Use of Storage Batteries

A storage battery cannot be considered as taking the place of spare capacity. Its function is rather to take over immediately and automatically the load of an exciter which trips by relay action or ceases to generate and to carry that load until the exciter is restored to service or a spare put in its place. It does away with the necessity of keeping spare exciters on the bus and thereby permits more efficient operation. A battery is said to be justified only if the cost of operating spare exciters on the bus, or if the value of increased assurance of continuous service during times when no spare exciters are available, is greater than the fixed and operating costs of the battery. The storage battery must be at least large enough to take over the entire load of one of the exciters for ten minutes. The battery system A therefore most be larger than the battery for any of the other systems. It is not customary in systems A and B to make the storage battery larger than would be necessary to carry the entire load for more than one hour, seldom for more than one-half hour.



SCHEMATIC DIAGRAMS OF FOUR EXCITATION SYSTEMS

Regarding space requirements, it is said that this is important only to the extent that it affects the building and substructure costs. Definite space limitations may exist in a crowded city station.

While it has not been found possible to arrive at any definite comparison of costs that would be of value to any one intending to select a system of excitation for a certain station, it is probable that system D will cost more than any of the other systems. System A will cost more than systems B and C in any except a very low-head plant having a large number of units. Relative costs for high and low heads are given in the table of comparison. For a very low-head plant the advantage in favor of the direct-connected systems will be lessened by the rapidly increasing cost of the low-speed exciters.

Maintenance, material and labor are dependent on the

number of pieces and the class of equipment and the amount of complication rather than on the system used. Ten small exciters will thus require about ten times as much maintenance as one large exciter. For efficiency comparison the following table gives comparative overall efficiencies for the various systems in the case of a hydro-electric plant, assuming the efficiencies of the component parts to be as indicated. Full-load efficiencies are assumed, and no attempt was made to make a comparison on the basis of all-day efficiencies or to take into account various operating considerations which might interfere with obtaining best results.

Rheostat losses may be reduced in systems A and B if voltage regulators are used on exciters. It is evident from this table that the direct-connected systems without rheostats give the best efficiencies. The direct-connected systems will also probably have the best all-day efficiencies. A similar table for a steam plant cannot be conveniently drawn up on account of the varying conditions and the extent to which the exhaust steam is utilized.

Regarding the effect of short circuit on a feeder or on the bus which is not cleared promptly, this has in some cases caused a reversal of exciter polarity even though the exciters were shunt-wound. Except in the case of compound exciters on central systems, however, reversals will be of rare occurrence. Speed fluctuation with resultant variation of exciter voltage is the most important effect of short circuits and may be partially overcome by voltage regulators. System D is the most desirable in this respect. System A is the next best, being almost equal to system D if the exciters are prime-mover-driven or if the motor-driven exciter load can be picked up by other exciters or battery. System C has a slight preference over system B, which is the least desirable.

In case of trouble causing generators to fall out of step, with separately driven exciters of either the central or individual system there is more chance of the generators coming back into step than there is with the direct-connected exciters of either the central or individual systems, as the better the excitation the more will be the synchronizing power between machines. Systems D and A are preferable to systems B and C.

From the standpoint of physical simplicity, if the number of units is small, system C is the simplest in that it has no special prime movers, governors, steam

COMPARISON OF EXCITATION EFFICIENCIES FOR HYDRO STATION

Apparatus	— System of Excitation (per Cent of Efficiency) — A Central Separate	B Central Direct	C Individual Direct	D Individual Separate
Prime-Mover-Driven:				
Turbine	85	90	90	85
Exciter	93	90	90	A-C gen. 94
Rheostats	80	80	..	Motor gen. 85
Over all	63	65	81	67
Motor-Driven:				
Main turbine	90	..	..	90
Main generator	96	..	..	96
Transformer	98	..	..	98
Motor-generator set	87	..	..	85
Rheostats	80	..	..	..
Over all	59	..	..	72

(By emergency transformers)

COMPARISON OF SYSTEMS

	A Central Separate	B Central Direct	C Individual Direct	D Individual Separate
(1)—Power supply to auxiliaries	Good	Good	Not suitable	Excellent
(2)—Automatic voltage regulation	If used for auxiliaries or with battery requires booster system of regulation		Permits use of individual regulators	
(3)—Use of storage battery	Most advantageous use of battery. Requires booster system of regulation		Battery cannot be floated.	Can be used only with complications
(4)—Space requirements	Large	Small	Small	Large
(5)—Initial cost (A = 100%)				
Low-head hydro	100%	70% to 90%	70% to 90%	120% to 140%
Steam or high-head hydro	100%	50% to 70%	50% to 70%	120% to 140%
(6)—Efficiency (hydro, including rheostats)	Good	Excellent	Excellent	Poor
(7)—Effect of power system troubles				
(a) Sustained short circuit	Prime-mover-driven exciters unaffected. Speed of motor-driven exciters affected	If speed increases, higher short-circuit currents and better synchronizing power. If speed decreases, lower short-circuit currents and lower synchronizing power		Unaffected
(b) Sudden loss of load	Speed of motor-driven exciters affected	Speed of exciters affected		Unaffected
(c) Generators falling out of step	Speed of motor-driven exciters may be affected	Speed of some of exciters affected. Synchronizing power may be decreased		Unaffected
(d) Opening of fields to clear line trouble	Excitation unchanged	If speed is below normal, generators are more likely to fall out of step owing to poor reduced excitation		Excitation unchanged
(e) Splitting station with regulator potential on one section and compensating coil on other section	Voltage fluctuation equal to twice line drop compensation results		Unaffected with individual regulators. If only one regulator voltage fluctuation results	
(f) Shutdown of generator with direct-connected exciter needed for other units	Unaffected	Serious disturbance to service	Loss of excitation on a running generator which may fall out of step	Unaffected
(8)—Effect of exciter system troubles				
(a) Ice and trash (hydro)	Serious reduction of service unless ample motor-driven spare is available	Unaffected	Unaffected	Serious reduction of service unless ample motor-driven or transformer spare is available
(b) Short-circuited exciter	Unaffected if exciter can be spared. Serious if exciter cannot be spared		If generator is large in comparison with size of system it may fall out of step	
(c) Short circuit on exciter bus	Short circuit usually clears itself. If not total interruption results		Unaffected	Short circuit usually clears itself. If not total interruption results
(d) Accidental shutdown of exciter	Serious disturbance unless exciter can be spared		Unaffected	If d. c. exciter, may cause generator to fall out of step. If a. c. exciter serious disturbance unless machine can be spared
(e) Open circuit in exciter field	Serious disturbance unless exciter can be spared		Generator may fall out of step	
(f) High voltage from opening last exciter breaker	Affects entire excitation system. May cause breakdown of insulation. Will blow fuses and breakers on auxiliary circuits		Ordinarily not possible. In any event affects only one unit	
(g) Regulator troubles	Affects entire system		Affects entire system if only one regulator is used and only one unit if individual regulators are used	
(9)—Simplicity physical	Simple for small or moderate size station. Complicated if many exciters and battery are used		Very simple for small number of generators. Complicated for large number of generators	Complicated
Normal operation	Simplest	Simple	Simple	Complicated
During trouble	Simple	Complicated	Complicated	Simplest
(10)—Reliability	Depends on number of pieces of equipment, amount of remote control, automatic and regulating devices.			

piping, penstocks, headgates, screens, etc.; in that the volume of substructure and building occupied by excitation equipment is small, and also in that ordinarily the system has no rheostats. If the number of units in the station is large, system C is complicated by the addition of so many more exciter units with their regulators. System B is not more complicated than system C when the latter uses a bus and generator field rheostats. System A can be almost as simple as system C, or considerably more complicated, depending on the amount of equipment installed. If only two exciters are used and if these are steam-driven, it compares very favorably with system C for physical simplicity. If a motor-driven exciter and battery are added, system A becomes more complicated than system C except for a large number of generators. System D is physically the most complicated.

From the operating standpoint, considering both normal and trouble operation, system A for a small station is the simplest provided that the exciters are not compound-wound. If steam-driven exciters are used, the complications of heat balance are introduced. If system A has more than two or three exciters, some of them motor-driven, it becomes more complicated with respect to normal operation than system C. With respect to operation during power-system trouble, system A is simpler than system C, especially if only prime-mover-driven exciters are used or if a battery is provided. System B is more complicated from the operating standpoint than either systems A or C. System D is the simplest of all to handle during power-system trouble, but for normal operation is not so simple as the other systems on account of the many operations involved in starting and stopping.

It should be noted that the simplest system fundamentally can be made the most complicated by attempts to make it too flexible, by the addition of an undue amount of remote control and automatic features, or by awkward location of various parts of the system such as putting switches at points which are not easily accessible to the operators.

Under the heading of reliability this discussion is intended to cover merely the inherent reliability of the equipment itself. From this standpoint reliability does not become an important factor in determining the system of excitation for the reason that any of the systems properly designed and laid out in accordance with good practice are very reliable. Many more troubles will be caused by the operating characteristics than by the breakdown of excitation equipment. The number of breakdowns, however, will be proportional to the number of units in use.

CHOOSING NUMBER AND SIZE OF EXCITERS

In every case the number and size of exciters should be such that the largest exciter can be taken out of service at any time without interfering with the operation of the station. In a few large, important stations it may be advisable to provide for a second exciter being out of service. The ultimate as well as the immediate exciter requirements should be kept in mind in laying out the equipment. The present exciter equipment should as far as possible be such that it can be used to best advantage in the ultimate layout.

For motor-driven exciters the induction motor is satisfactory and preferable in almost every case. The induction motor will ride through almost any kind of disturbance on the main power system even though the voltage may remain low for a considerable length of time. Generally speaking, synchronous motors are more likely to fall out of step during main system troubles, and having a direct-current field requires one additional operation on the part of the operator when starting. In favor of the synchronous motor it may be said that it is possible to specify a synchronous motor in stability during power-system trouble.

Combination motor and turbine drive, either hydraulic or steam, is in successful use and offers a very good way of making a system having two exciters independent of either prime-mover trouble or power-system trouble. Without the installation of any automatic equipment not ordinarily used, this system functions practically automatically. If the exciters are being driven by the motors, loss of voltage with resultant reduction of speed permits the prime-mover governors to function and transfers the drive to the prime mover. When voltage is restored to the motors the increased speed automatically cuts out the prime movers.

Wherever it is necessary that exciters be operated in parallel it is recommended that shunt-wound exciters be used, especially if the exciters are to be controlled by voltage regulators. The instances of compound-wound exciters causing trouble are so many that in spite of all the explanations of causes that may be given it is difficult to convince an operating man that has been through these experiences that compound-wound exciters should ever be used where exciters are operated in parallel.

It is believed that 125 volts is satisfactory for small plants, but for moderate size and large plants 250 volts is preferable from the standpoint of reduced cost and size of apparatus and cables. Where station lighting is at 250 volts alternating current the exciter bus can be used for emergency lighting service if it also is at 250 volts. It is suggested that for large stations consideration may be given to higher voltages than those at present in use, possibly 500 volts or 550 volts.

Bus connections and exciter and field connections should be made as simple as possible consistently with the required degree of flexibility. If complete flexibility is attempted, it is almost certain to result in bus connections which are too complicated to be easily operated and which will be the cause of operating mistakes. A bus arrangement which permits of the exciters being paralleled by more than one set of switches is likely to be dangerous.

The minimum amount of automatic protective equipment consistent with safety to service and apparatus should be installed. The class of attendance which the apparatus is to receive should be kept in mind if unusual or complicated devices are contemplated.

Generator-field breakers are always non-automatic unless some kind of field-destroying device is used. Reverse-current relays should be used on exciters which are to operate in parallel with other exciters or with a battery, but no overload relays should be used. Reverse-current relays for this service are generally not very reliable, but as there is no adequate substitute it is necessary to install them. Low-voltage release on circuit breakers is not considered advisable.

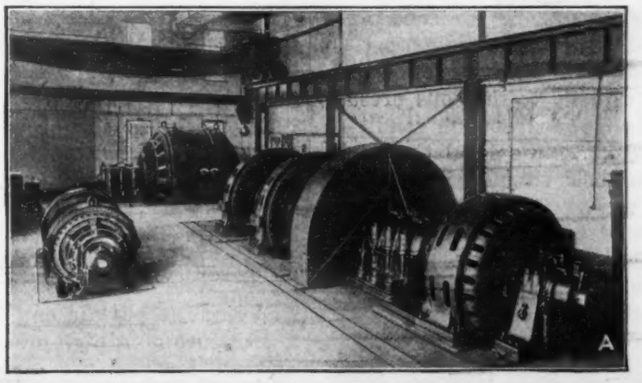
It is recommended that all exciter equipment which is likely to run away, particularly motor-generator sets, be provided with speed-limit devices independent of any protection which might be expected from reverse current relays.

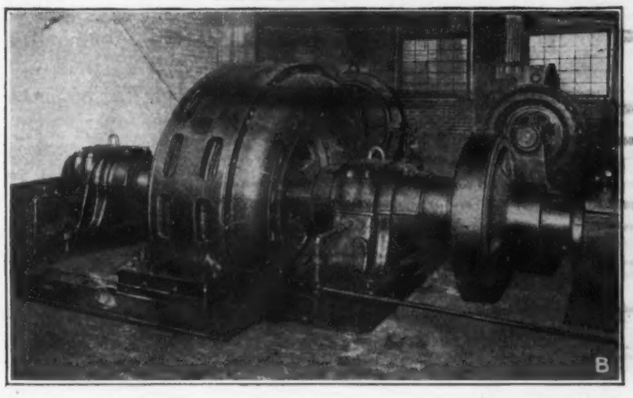
Keeping Steel-Mill Motors in Service

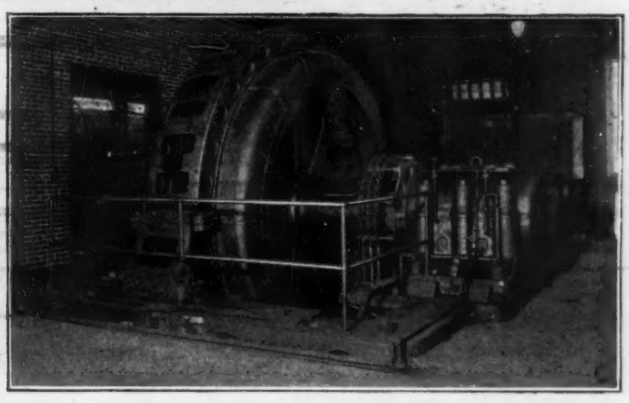
Tests of Various Kinds Are Prescribed for Main Mill Motors Before They Are Started Up and Periodically Thereafter in Order to Let the User Know the Condition of the Insulation in Machines

By O. NEEDHAM
General Engineer Westinghouse Electric & Manufacturing Company

STANDARD control devices have been developed to protect large steel-mill and other motors from overloads and from high voltage, but these abnormal conditions, as well as dirt, moisture, etc., will cause the insulation of the machines to deteriorate in time. Furthermore, the insulation often takes up moisture after the machine leaves the factory and before it is put into service. It is therefore the purpose of this article to suggest methods for drying out the insulation of large steel-mill motors and for making periodical overvoltage tests at times when machines can be best spared and, if necessary, repaired. Faults found in this way are in most cases easier to repair and cause less loss in mill production than when machines are allowed to run until they break down in service.







TYPICAL MILL MOTORS REQUIRING PERIODICAL TESTS

A—View of motor house containing electrical equipment for driving a 34-in. reversing blooming mill. The direct-current reversing mill motor in the background has a maximum rating of 10,000 hp. at from zero to 100 r.p.m. This motor receives its energy from the flywheel motor-generator set on the right. The induction motor of this set is rated at 1,800 hp., 2,200 volts, three-phase, 66⅔ cycles, and the flywheel weighs 100,000 lb.

B—An 800-hp., 2,200-volt, three-phase, 60-cycle, 270-r.p.m. induction motor driving a 10-in. merchant mill.

C—A 132-in. sheared-plate mill that is driven by the 5,000-hp. 2,200-volt, three-phase, 60-cycle induction motor, operating at a speed of 197 r.p.m.

After machines are completely set up in position they should be thoroughly dried out and then tested before being started. The drying can be done by applying heat externally or by circulating current in the windings. External drying can be done by placing resistance grids under the machines to dissipate roughly about 1 kw. per 100 hp. rating of the machine, but no part of the hot grids should be allowed to come in contact with the windings. The machine should be covered with a tarpaulin and an opening provided at the top to allow the moisture to escape, otherwise it will condense on the machine as soon as the heat is discontinued. A thermometer should be kept on the windings and the temperature not allowed to exceed 90 deg. C., unless it is known positively that the insulation is of such a character that higher temperatures will not be injurious.

The time required to dry out a machine thoroughly will vary from a few days to several weeks, depending on the size of the machine and the condition in which the insulation is found. The insulation resistance should be tested two or three times a day at uniform intervals during the drying period, and a curve should be plotted using resistance as ordinates and hours as abscissas. A high-voltage megger is the most convenient method of measuring insulation resistance, but a high-resistance voltmeter and a 600-volt direct-current circuit can be used. In using a megger the instructions coming with the instrument should be carefully followed or misleading and erratic results may be obtained. These readings should be taken while the insulation is warm. When using a high-resistance voltmeter and an ungrounded 600-volt circuit, one side of the circuit is connected to the frame of the machine and the other side to the bare windings, through the voltmeter. If a grounded circuit is used, the grounded side should always be connected to the frame of the machine. The insulation resistance obtained in this manner will then equal:

$$R = \frac{(V - v)\,r}{v},$$

where R = the insulation resistance, r = the resistance of the voltmeter V = the line volts and v = the voltmeter reading. The temperature of the windings should

also be recorded at the time of taking the insulation resistance. These tests should be repeated at regular intervals until the curve shows that the insulation is thoroughly dry; *i.e.*, until there is no further change in resistance.

Machines which have been dried out by applying external heat only may show a very good value of insulation resistance with a megger and still have moisture in the insulation next to the conductor. This is particularly true of high-voltage machines where the insulation is heavy and it is very difficult to entirely drive out the moisture. A much more effective method is to apply the heat internally by circulating current through the windings. Machines of 2,200 volts or higher can generally be dried out by applying 220 volts alternating current directly to the terminals without interposing resistance. The machines should be watched very closely at first by observing thermometers placed on the coils to make sure that there is no overheating. The application of current directly to the coils presupposes that the insulation is in good enough condition to withstand this low voltage. If the insulation is in very poor condition, external heat should be used until it is safe to apply a low voltage for circulating current. Megger readings should then be taken until the insulation resistance reaches a fixed value.

The American Institute of Electrical Engineers recommendation for insulation resistance is:

$$\text{Megohms} = \text{voltage} \div (\text{kva.} + 1{,}000).$$

This value seems to be low for large steel-mill apparatus, and particularly for 2,200-volt machines, which should show at least one megohm per 1,000 volts. It is not the intention that the drying process should be stopped when these values are reached, but in every case the process should be continued until the resistance is constant. If this constant value does not equal that given in the above rule, the manufacturer of the apparatus should be notified.

Machines can be placed in service after the above precautions have been taken with reasonable assurance that the insulation will stand up. However, where continuity of service is important many operators give large apparatus the same insulation test (double voltage + 1,000 volts) that it receives in the factory before shipment. Megger tests, although serving as a measure of precaution, cannot be entirely relied upon, as it is possible to show good resistance values when the insulation is on the verge of a breakdown. The only reliable method of measuring the ability of the insulation to withstand operating voltage is to apply actual potential test to the insulation. This requires a small testing transformer designed to give a wide range of voltage and with a capacity of about 1 kva. per 1,000 volts on the high-tension side.

A voltage test can be applied for a period of one minute, and if a weak point is found, very little damage is done, owing to the small capacity of the transformer. If, on the other hand, the apparatus is allowed to break down in service, it may be connected to a power circuit having considerable capacity, and when the trouble occurs the large amount of power available may damage the machine seriously. Such a breakdown naturally occurs when the mill is in operation, and it causes serious delay. If a testing transformer is used, the fault can be found before the equipment is started up and the repairs made before the mill is placed in operation.

It is advisable to keep all machines painted while they are in regular service. The paint will not only be a benefit to the machines by preventing rust and also making them easier to clean, but it will be an incentive to the operator and attendants to keep the motor room and apparatus neat and clean. In addition to painting the iron and steel parts of the machines the exposed parts of the windings, and particularly the creepage surfaces over the insulation, should be gone over at least once a year with a good insulating varnish. Most of these varnishes will dry in from twenty-four to forty-eight hours with a room temperature of approximately 80 deg. Fahr. (27 deg. C.). If this amount of time cannot be spared, the varnish can be dried more quickly by covering the machines with a tarpaulin, leaving an opening at the top and placing resistance grids under the machine to dissipate energy, as previously mentioned. This treatment will cause the insulation to become smooth and glossy so that dirt will not readily adhere to its surface.

All machines should be periodically inspected, say every week or two, at which time the machine should be thoroughly blown out with a moderate-pressure air blast. About 25 lb. to 30 lb. per square inch (4.4 kg. to 5.4 kg. per sq.cm.) is most satisfactory. As the mill air line is usually operated at a high pressure, it is advisable to provide a reducing valve and water trap so as to obviate any danger to the insulation due to moisture or a high-pressure blast. In some cases a separate low-pressure air compressor is installed for blowing out the motors, etc. Care should be taken to prevent dirt from getting into the bearings during this cleaning process.

Steel-mill motors should be entirely overhauled, both mechanically and electrically, at least once every year. Local conditions will dictate the time of year when a unit can best be spared for a long enough period to make the test and to make repairs should a breakdown occur as a result of the test. At more frequent inspection periods the hot insulation resistance should be measured, and a permanent record should be kept of these tests. They will show whether any deterioration of insulation is taking place. When such is the case preventive steps can be taken before an actual breakdown occurs.

It is unfortunate that insulation must be subjected to the danger of breakdown by overvoltage test in order to find out if it is in proper condition, but this should not deter the operating engineer from making such tests. There are many different opinions as to the best percentage of operating voltage to apply when making a high-potential insulation test. The double-voltage plus 1,000 volts applied when the apparatus is new is presumably a larger margin of safety than is reasonable after the apparatus has been in service for a period of years. It is the writer's opinion that 150 per cent of normal voltage is the minimum to which the insulation should be allowed to deteriorate. If the insulation will break down on the application of 50 per cent in excess of normal voltage, the apparatus should be rewound or some other radical steps should be taken to strengthen the insulation.

Whatever high-potential test is made should be applied with caution. The machine should be blown out and all brass and copper parts wiped clean, as the presence of dirt may cause a failure even when the insulation is in good condition. The insulation must

also be dry and should show a good resistance value. The terminals from the testing transformer should then be placed on the machine to be tested while the testing circuit is dead. Then the high voltage should be applied by closing the low-voltage circuit of the transformer. When the test is completed the high voltage should be removed by opening the low-voltage circuit. The severity of the test depends to a marked degree upon the time the electromotive force is applied, and it is suggested that these tests be of not over one minute in duration.

Governor Adjustment for Efficient Parallel Operation

Principles of Operating Steam and Hydro Plants in Parallel and Methods of Changing Governor Regulation While Running

BY F. OPPENHEIMER
Pennsylvania Water & Power Company, Holtwood, Pa.

SOME principles of governor operation have recently taken on a new significance in efficient distribution of load among units and stations running in parallel. Most important among these are: (1) To make the most economical units carry the main body of the load; (2) to allow a relatively small unit to take care of fluctuations, and at the same time (3) to maintain good speed regulation of the whole system. To follow these principles an operator must have a knowledge of the operation of generators in parallel with various governor adjustments on the prime movers.

Let it be supposed that there are five units all exactly alike running in parallel, with all governors set for the same regulation, but that the operator has manipulated the individual governors so that the loads are unequal (Fig. 1). In order to eliminate the undesirable unequal loading it is an easy matter for the operator to pull up on No. 4 and No. 5 units and down on Nos. 1 and 2 so that all the lines will coincide with the curve of No. 3 unit as shown in Fig. 2.

In the case supposed all the governors had the same speed-load characteristics, a condition hardly ever found in one station or one system. To get a more real condition let it be supposed that unit No. 6, rated at 40,000 kw., with a speed-load curve as shown in *B*, Fig. 3, is put on the line in parallel with the others in station *A*. In order that all units shall share the load in exact proportion to size at all speeds it is necessary to regulate the governors so that each unit will change its speed the same amount from no load to full load. If it is desired to change *B*, it will have to give a line *B'''* on which an increase in load from 0 kw. to 40,000 kw. will produce a decrease in speed of 5 r.p.m. (103 — 98), which corresponds to a like change in speed on units *A* for load change from 0 kw. to 10,000 kw. per unit. In order to show more clearly what this means the curves of Fig. 3 are again plotted in Fig. 4, where the load is given in percentage of rated capacity.

If all the governors in one station or on one system were adjusted to give the same regulation, they would divide the load in proportion to their size as in curve *A* and *B'''* (Fig. 4). However, in most systems this is not desirable, as there are generating units which differ greatly in efficiency and capacity, so that it may be better to run a certain type of unit well loaded all the time and take up fluctuations in the system load on another type of unit. A specific case may be assumed where a 40,000-kw. unit operates in parallel with a 10,000-kw. unit and the total load is 40,000 kw. Tests of the units may indicate that the large unit is very efficient at 35,000 kw. and that the best over-all efficiency of the system is obtained by keeping this unit at that load all day if possible. The regulation of the governors in this case should be, in principle, as shown in Fig. 5, where it is seen that small changes in speed affect the amount of load on the large unit very little but cause the smaller unit to take nearly the total amount of the fluctuations in system load. An interesting point to be noted is that in any system the magnitude of the speed fluctuations varies inversely as the number of governors functioning (other things being the same). For instance, in a hydro-electric station of ten units carrying load enough for nine and one-half units, if nine units are operated with gates wide open and one unit at half load, all load fluctuations (up to certain limits) will be taken by the unit at half load, since this is the only governor that is actually doing any regulating. But if each of the ten units carries

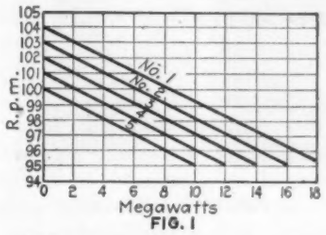


FIG. 1

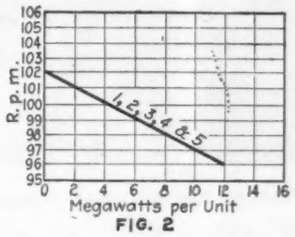


FIG. 2

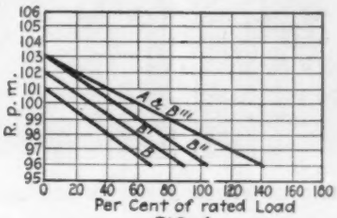


FIG. 4

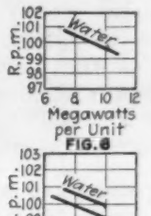


FIG. 6

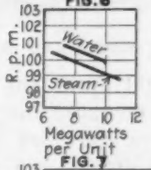


FIG. 7

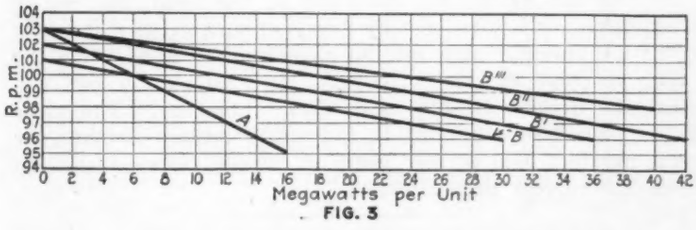


FIG. 3

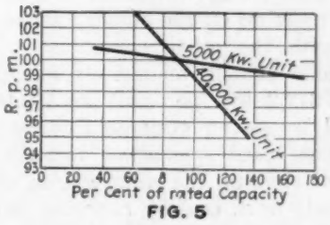


FIG. 5

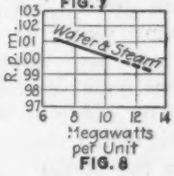


FIG. 8

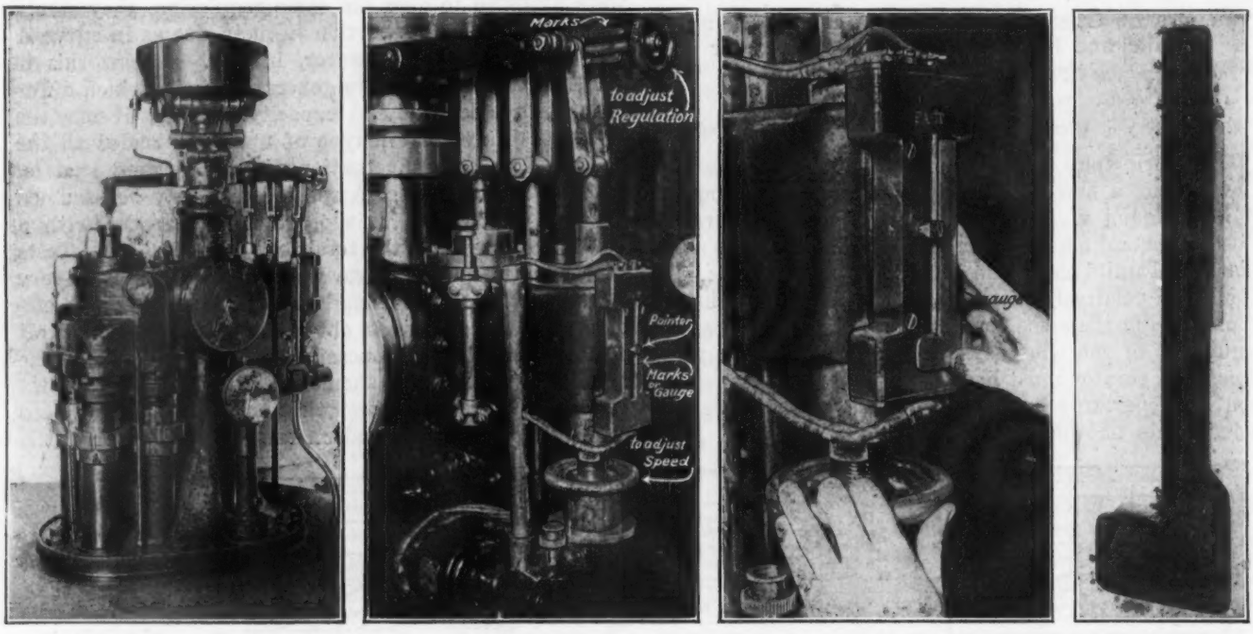
SPEED-LOAD CURVES OF PRIME MOVERS WITH VARIOUS GOVERNOR ADJUSTMENTS

Fig. 1—Five identical units operating in parallel but with governors adjusted for different speeds. Fig. 2—Governors of Fig. 1 have been adjusted so that all units are equally loaded. Fig. 3—10,000-kw. unit (*A*) operating in parallel with 40,000-kw. unit (*B*, *B'*, *B''* and *B'''*). Fig. 4—Same as Fig. 3 with loads shown in per cent. Fig. 5—40,000-kw. water-power unit carries steady load of about 35,000 kw., while 5,000-kw. steam unit takes fluctuations, as a small drop in speed causes a large increase in load on the steam unit. Figs. 7 and 8—Various conditions of operating steam-driven and water-driven units in parallel.

95 per cent of its maximum capacity, there will be ten governors functioning, and each will have to take one-tenth as much of the load fluctuations with a consequent variation in speed of only one-tenth as much as before.

The operation of the hydro-electric station just mentioned, running parallel with a steam station, is shown graphically in Fig. 6 to Fig. 8. Fig. 6 shows the speed-load curve of ten water-driven units, each carrying 9,000 kw. at 100 r.p.m. The load increases and a steam-driven unit is put on the line as shown in Fig. 7, where the waterwheels are wide open at 10,000 kw. each and the steam unit has 8,000 kw. Note that the slope of the curves is the same and that an increase of 3,000 kw. would lower the speed one revolution, whereas in Fig. 6 with ten governors working an increase of the same total amount, or 300 per unit, would lower the speed only one-tenth revolution. If the operator now pulls up on the steam unit so that its curve coincides with the other curve, as in Fig. 8, and divides the load equally among eleven units, the result would be 9817.2 kw. pe unit at 100.06 r.p.m. Thus there would b eleven governors working, with consequent excellent speed regulation, but they would waste water by not running the waterwheels wide open and would needlessly burn coal by carrying 9817.2 kw. on the steam instead of 8,000 kw. as in Fig. 7. Of course, the amount of fluctuation in load may dictate the least number of governors required to maintain a certain standard of speed regulation. Before shutting down the steam unit it will be desirable to "back down" on all the waterwheel units, so that they are no longer wide open and can therefore regulate the speed, and at the same time to keep the speed up to 100 the operator has to pull up on the steam unit.

It may be desirable to change the adjustment of governors from time to time in order to get the best efficiency or certain regulation or speed characteristics under various operating conditions. In order that such adjustments may be made quickly and accurately it is a good plan to put marks on the governor mechanism to which certain adjustable parts can be set by the attendant, or it may be advantageous to have metal gages or templates for the same purpose. This makes it possible to change the speed characteristics of a prime mover to a predetermined value while it is in operation. In the Holtwood (Pa.) plant of the Pennsylvania Water & Power Company both of those methods are used on the I. P. Morris double-floating-lever governors which are on all units. The brass gage at the right of the illustration fits directly on the governor over the speed-adjusting wheel. The gage has a mark for each of the eight units in the plant showing the setting for full load at rated speed. When all governors are set by this gage, the units divide the load in proportion to their rating. This will hold, of course, only if the regulation of the governors is the same. As a guide in setting the regulation to a certain amount of speed change for a certain load increase, marks are placed at the top of the governor at the handwheel which changes regulation. By means of such gages and marks an operator may set the governors by hand while the machine is running, so that the total station load will be divided in the most efficient manner. The same principle is applied to the entire system so that the system load of any value is divided between stations in correct proportions.



GAGES AND MARKINGS WHICH ASSIST IN ADJUSTING GOVERNOR FOR DIFFERENT CONDITIONS OF PARALLEL OPERATION

A PUBLIC SERVICE *company, in its broadest sense, is a partnership consisting of the state as an institution, the public as a group of customers, and the company, the state determining the extent to which the company may go, the company furnishing the facilities, and that part of the public constituting the customers furnishing the revenue with which the company is enabled to perform its service. Any act or omission which denies a public service company a reasonable approximation to a fair deal has its immediate and reflex effect upon the customers; and if it is one of the important functions of a public service commission to see that the company and its patrons are treating each other fairly, no lower in the scale stands the duty of seeing to it that the company and its customers are each accorded full justice by every outside agency.*—From a decision of Maine Public Utilities Commission.

Readers' Views and Comments

Electric Welding Machinery

To the Editor of the ELECTRICAL WORLD:

SIR: In your issue of July 10, covering the electric welding session of the A. I. Ξ. E. meeting at White Sulphur Springs, several statements are made which are not exactly in accordance with the facts. At that meeting welding machines were described by A. M. Candy, S. R. Bergman, R. L. Unland and C. J. Holslag, all of them purported to be new and original. The facts are that all of these different welding machines in their essentials were invented, manufactured and placed on the market years ago by the Lincoln Electric Company. They are in no case being manufactured now by this company for the reason that their development has shown that these older types are not entirely satisfactory.

The machine described by Mr. Holslag is an alternating-current transformer, the first one of which for welding purposes, as far as the writer knows, was manufactured in 1907 by the Lincoln Electric Company, placed in operation by the Cleveland Steel Casting Company, Cleveland, Ohio, and was in operation there for a period of months. The same difficulties were present in this machine as are present in the same types now, that is, unstableness of the arc, low-power factor, poor penetration and great difficulty of operation. For these reasons this type was abandoned by the Lincoln Electric Company as being unsatisfactory.

The machine described by A. M. Candy, which is technically known here as the double-shunt machine, is essentially covered by patent No. 1,295,278, issued to this company. Machines of this kind were developed and put into operation during 1913 and 1914. They are at the present time in operation in hundreds of places, examples of which are the Timken Detroit Axle Company, Detroit, Mich.; Strong Steel Foundry Company, Buffalo, N. Y.; the Rock Island Railroad and others. While this scheme produced successful welding equipment, it was abandoned by this company years ago for the following reasons: First, the current regulation of the arc was difficult and with wide variations unstable; second, when the arc was struck the collapse of the self-excited field was sufficient to give a strong tendency toward sparking; third, the adjustment of the flux density in the magnetic circuit was sluggish for the same reason. This machine was fairly successful, although its complication and the difficulty noted above caused its rejection by the Lincoln Electric Company years ago.

The type of machine described by Mr. Bergman and Mr. Unland is essentially the same as the machine developed by this company under patent No. 1,227,809. This was developed in the period between 1909 and 1910. A number of these machines are in operation. Examples are the Henrici Laundry Company, Boston, Mass.; West Steel Casting Company, Cleveland, Ohio; Michigan Malleable Iron Company, Detroit, Mich.; Union Steel Castings Company, Pittsburgh, Pa., and a number of others. This scheme was abandoned on account of the difficulty which developed in service. It is self-evident that an armature reaction which will neutralize the main field to the extent of giving a drooping characteristic that will drop the voltage to practically nothing at the same time will have the same effect on the commutating field and result in difficulty in commutation, thus tending to make the machine cranky at the commutator and rather complicated because of its design. This machine was abandoned nearly ten years ago for the reasons cited above.

The type which has been developed from these various stages is the type covered by Patent No. 1,238,406. This is a single separately excited shunt field with a bucking series and overcomes all of the difficulties experienced with the other types. We do not claim that these other types will not weld, as our experience and the large number of these types in operation prove that they will weld. Experience with them, however, shows that they have difficulties which should be overcome, and the final type mentioned and now manufactured by this company does overcome them.

THE LINCOLN ELECTRIC COMPANY,
Cleveland, Ohio. J. F. LINCOLN, Vice-president.

Vacuum-Tube Amplifiers

To the Editor of the ELECTRICAL WORLD:

SIR: My attention was drawn only today (June 17) to the article published in your paper of March 29, 1919, over the signature of Lieut. Max C. Batsel, in relation to vacuum-tube amplifiers. The author of that article contents himself with saying: "The development work on radio-frequency amplifiers has been carried out entirely by Signal Corps engineers assisted in its initial stages by information gained from the French and the British."

In reality the apparatus described by the author of the article represents substantial reproductions by the Signal Corps of apparatus devised by me for the French military telegraphs in 1916 under the designations "3-ter, L_1, L_2, L_3, L_3-bis," and which was manufactured by thousands. I can even say that the magnetic circuit of the low-frequency transformers for the American amplifiers (see Fig. 1 of the article) has exactly the same form and dimensions as the magnetic circuit of the transformers for the amplifier of type "3-ter."

In regard to the utilization of transformers having a magnetic circuit of iron of low capacity in high-frequency amplifiers, I did that in the amplifiers of type L in 1916 without having had any knowledge of any similar amplification made before that time in any country. The type "L_3 bis" even comprises air-gap transformers like those shown in Fig. 5 of the article, which is perfectly familiar to me. The arrangement shown in Fig. 9 is simply that of the type "L" apparatus, and it therefore comprises a combination of high and low-frequency amplifications with capacities on the low-frequency transformers.

I am aware of the high technical merit of the Americans, and I know all that they have done in the field of amplification. Still, I believe that my practical work in this line was of some usefulness to the American army and that it deserved more than the anonymous reference made to it by the author of the article referred to.

MARIUS LATOUR.
Paris, France.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Portable Ladder Platform for Low Wire Work

PORTABLE PLATFORM MADE OF CROSSED LADDERS AND PLANK

TWO crossed ladders lashed to an overhead line and provided with a platform of single planking are used successfully in low-hanging cable and wire maintenance work by a southern New England company, as illustrated in the accompanying photograph. Notwithstanding the lightness of this arrangement, it is mechanically stable and provides space for two men to work conveniently and safely on sections of line carried near the ground, as in the viaduct instance illustrated. In looping the supporting straps around the ladders, care is taken to run them below the planking, thus avoiding any tendency for the strap to slip off the top of the ladder. Both vertical and horizontal adjustments of this improvised platform can be made with great rapidity and without difficulty by shifting the plank.

Boilers Should Be Tagged When Being Worked On

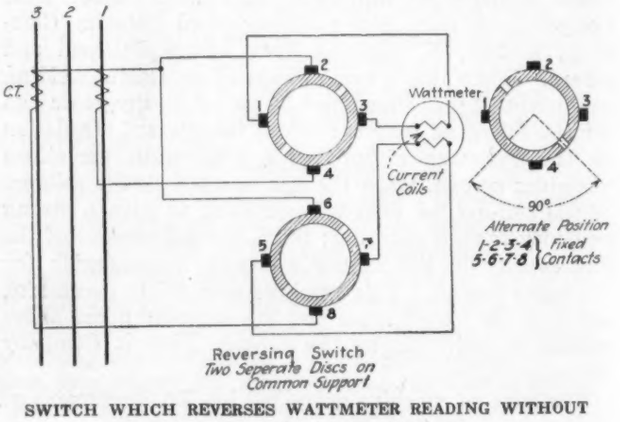
IN ORDER to protect men working in boilers, blow-off and other valves should be properly tagged. An accident that occurred recently in the plant of the Consumers' Power Company, Jackson, Mich., though fortunately not fatal, emphasizes the necessity for workmen to follow a specified safe method of procedure. As a common blow-off header is used with a battery of boilers, if any boiler of that battery is blown down, the dead boiler, with the blow-off valves open, will be filled with scalding water, which will flash in part into steam due to the reduced pressure. If any one should be working in the boiler, a bad accident could scarcely be averted.

In order to prevent such an occurrence this company has developed a system of tagging the blow-off valves and recording the procedure in a log book similar to that used on transmission lines. According to this system, when a boiler is not fired up, the blow-off valve must be closed and tagged for the plant engineer or whoever is in charge of the boiler-room operating force, and a record of this action must be made in the boiler-room log book. In case men working in the boiler want the blow-off valves open, as, for instance, while turbining boiler tubes, the one in charge of the work must notify the plant engineer, who will remove the tag on the blow-off valve in question and place tags on the blow-off valves of the boilers that blow down into the same header. In this way the water tender will not blow down a boiler without first seeing that the blow-off valves to the dead boiler are closed. As soon as the work is completed within the dead boiler the one for whom the blow-off valves are tagged must notify the plant engineer, who will see that the tags for this man are removed from the blow-off valves of the boilers and that the blow-off valves of the boiler in question are closed and tagged again for himself. A complete record of all operations is entered in the boiler-room log book. In short, no one should operate the blow-off valves but the man who is responsible for the blowing down of the boilers, no matter whether the boiler is dead or fired up, and the necessary tags must be placed and records be made so as to eliminate any possibility of a serious accident taking place. Boiler-room foremen are held directly responsible where this system is not followed.

Consumers' Power Company, Jackson, Mich. H. HURTH.

Home-Made Reversing Switch for Wattmeter

ALWAYS to get a positive reading on an indicating wattmeter connected to a circuit in which energy flows in both directions, the writer has modified a General Electric Company's ammeter jack. An ordinary reversing switch would not have answered for this purpose on account of the fact that it is not advisable to open the meter leads connected to current transformers. By



SWITCH WHICH REVERSES WATTMETER READING WITHOUT OPENING TRANSFORMER CIRCUIT

adapting the ammeter jack the current can be reversed without opening the circuits. The ammeter jack as it is manufactured has two cylindrical sections, one of which contains two sectors of copper on which two brushes make contact and the other of which contains six cop-

per sectors with six brushes. To make the change the first section was not altered but two brushes were added as shown in the accompanying drawing. The six sectors of the second section were removed and two large sectors were substituted and four brushes were connected up as shown. To reverse the switch the handle of the jack is turned through an angle of 90 deg., which causes both sections to turn simultaneously through this angle. As the brushes are wide enough to span the opening between the two copper sectors, the circuit from the current transformers always remains closed.

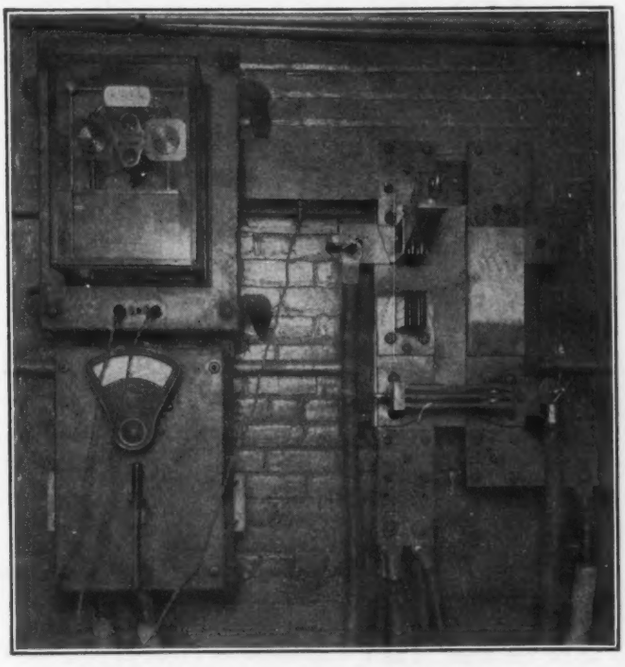
The station in which this meter is installed transmits power in each direction. The net result of the power is recorded by the watt-hour meter, and therefore the connections were so made that the current through the watt-hour meter is not reversed. R. H. N. LOCKYER.

Trail, B. C., Canada.

Shunting Switch Permits Testing Large Meter Without Killing Line

TO AVOID having to test a large railway meter of the Detroit Edison Company at night, when the circuit could be disconnected from the bus, two knife-blade switches were connected to the circuit as shown in the accompanying illustration. One of these switches when closed forms a shunt around the meter while the other switch opens the meter circuit. To test the meter after this meter circuit has been opened, current is sent through it from portable storage batteries through leads attached to the meter bus by temporary connectors. The current in the operating circuit passes across the lower switch and down through the outgoing cable.

Before the installation of these switches it was necessary to shut down this circuit to make a test. This was



METER IS BEING TESTED WHILE ITS CIRCUIT IS CARRYING A LOAD

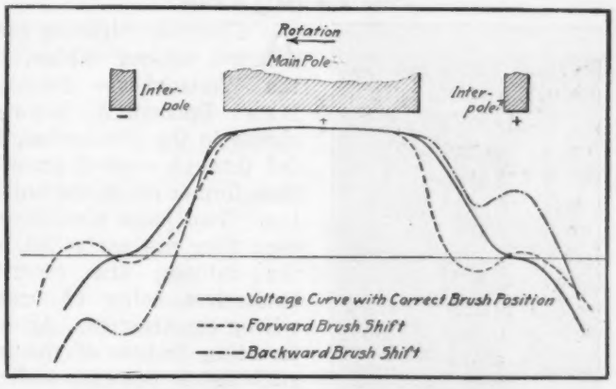
generally possible only at night, and the testing was very expensive on account of the great amount of overtime required. As the switch is now installed, the meter can be tested at any time independently of the load.

Detroit, Mich. J. S. MCCARTHY.

Shifting Brushes on Interpole Generators Changes Voltage

MUCH sparking and change of voltage may be caused on an interpole generator with a very slight shift of the brushes from the correct neutral point. When the brushes are shifted the interpoles either assist the main series field in raising the voltage as load comes on or buck the series field causing reduced voltage or too small an increase of voltage with the load.

If the brushes are given a forward shift, as is often



EFFECT OF BRUSH POSITION ON VOLTAGE OF INTERPOLE GENERATOR

done by operators accustomed to handling non-interpole machines, the coil which is sending current to the brush gets out from the influence of the interpole before it reaches the brush. In other words, the interpole acts on the coil when the coil is still in the field of the main pole just behind the interpole, which is of opposite polarity to the interpole. The net result is a reduction in the total flux and a consequent reduction of the generator voltage as the load increases. The remedy is to set the brushes at the correct position. It should be noted that the brushes may have been set so far ahead that they have reached a second neutral point, indicated in the accompanying diagram by the crossing of the zero line at the extreme left. In this case when an attempt is made to move the brushes back toward the correct position sparking may increase, but with the brushes moved still further back the sparking will again cease. A case of this kind recently occurred on a 300-kw., 250-volt machine in a steel plant. While cleaning the machine the operator had shifted the brushes to the non-sparking point just mentioned. The machine would not hold load properly, but when the operator attempted to shift the brushes back again the increased sparking alarmed him. However, after a troubleman had finally shifted the rocker ring back to the original mark the sparking stopped and the machine held up its voltage properly on load. The false neutral point was 2 in. (5 cm.) on the rocker ring ahead of the correct position.

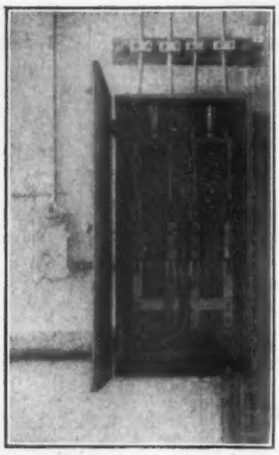
In case the brushes are given a backward shift, the interpole acts on the coil after it reaches the brush. As each interpole is of the same polarity as the main pole ahead of it, an extra amount of terminal voltage due to the interpole is added to the main field voltage and the terminal voltage of the machine will consequently increase with load. A very small amount of such shift, even half a bar, may cause sparking. In the diagram the voltage of the coil when the brushes are shifted backward is shown by the long dotted line.

Cleveland, Ohio. JAMES DIXON.

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Practical Cut-Out Cabinet with Watchman Switch Adjacent



WATCHMAN SWITCH NEAR LIGHTING CABINET

A TYPICAL lighting control cut-out cabinet in the Westinghouse factory, East Springfield, Mass., shown in the illustration, is fed through conduit from a transformer inside the building. Two main circuits on each floor are controlled by the cabinet, the circuits themselves being of open-wiring construction. An interesting feature of the installation is the snap switch at the left of the cabinet which controls the watchman's lights independently of the main floor lights. Only the few lamps which are connected on this circuit are lighted during the time the watchman is making his rounds.

Boston, Mass. H. S. KNOWLES.

Graphite in Belt Dressing Removes Static Electricity

FOR eliminating static electricity from belting in plants where very explosive vapors are present the safest method is probably to mix some graphite with the belt dressing. This makes the belt sufficiently conducting to prevent building up static voltage. An unsuccessful and probably dangerous method that has been tried in the past is to place wire points or pipe and other metallic objects in close proximity to the belt, connecting these objects with the ground in order that they may carry off the static electricity. Such a device, however, has been found ineffective because at times an accumulation of static electricity would pass in a spark from the belt to the device, thus defeating the purpose for which it was designed as the spark is liable to set fire to explosive vapor. A fire was started in this way in a certain japanning factory which afterward adopted the method of mixing graphite with the belt dressing. The new method eliminated the trouble, but it was necessary to keep a check on the condition of the dressing to be sure that it did not wear off. This was accomplished by means of a gold-leaf electroscope held near to the belt. The leaves of such an electroscope will diverge when in proximity to a belt holding static electricity.

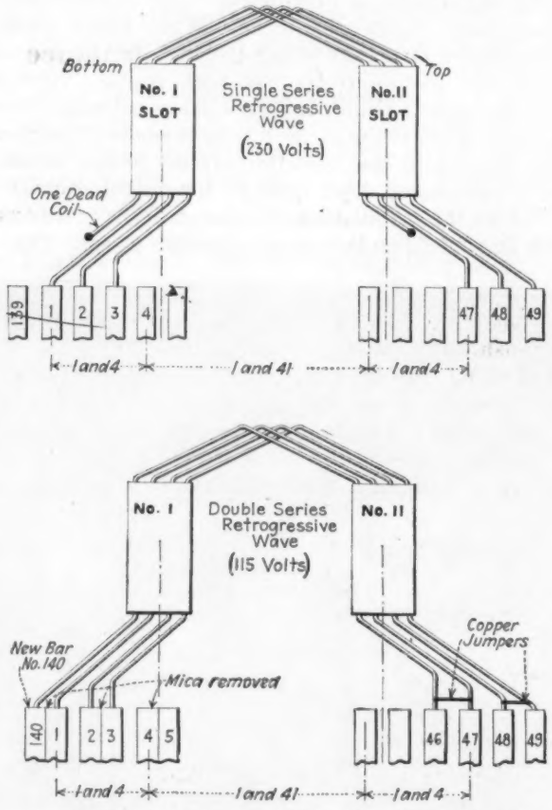
This electroscope was made from a wide-mouthed bottle, 2 in. (5 cm.) in diameter and 5 in. (12.5 cm.) high, in which was fitted a cork holding a piece of wire bent at right angles inside the bottle to hold the piece of goldleaf, which was about ¼ in. x 2 in. (6.4 mm. x 5 cm.) in size. An electroscope such as the one described will diverge when it is held in contact with a 600-volt circuit.

C. M. GREEN.

Lynn, Mass.

Halving Motor Voltage by Adding Commutator Bar

TO RECONNECT for 115 volts a 230-volt, six-pole series wave-wound motor with 139 commutator bars was a problem recently solved by a motor-repair shop. This job was especially difficult on account of the fact that as the motor had six poles, the winding could not be changed from wave winding to a lap winding in order to reduce the voltage. Therefore the motor had to be reconnected as a double-series (four-circuit-wave) winding. However, such a winding cannot be made with 139 commutator bars. Such a winding is possible with 137 bars, but this would necessitate killing two bars and two more of the 140 armature coils of which one was already killed. A 140-bar commutator, however, may be connected for a double-series winding



DOUBLE-SERIES WINDING MADE POSSIBLE BY ADDING A COMMUTATOR BAR

Bar No. 140 was inserted after thirty-two pieces of mica were removed.

which would alsc use all the 140 armature coi's. Therefore the coil leads were all unsoldered from the commutator necks, the commutator was opened, and the mica was removed from between every second pair of bars until sufficient room was made for adding another bar which was made in the shop. In all thirty-two pieces of mica were removed, making thirty-two bars of double width.

Where the mica had not been taken out copper jumpers were put between adjacent bars, making the whole virtually a seventy-bar commutator. New leads were then spliced on the dead coil and the armature was reconnected with a pitch on the commutator of one-to-forty-seven. As there were only thirty-five slots in the armature and 140 coils, the coils which were paralleled lay in the same slot so that there was no circulating current. After the armature was changed the fields were connected for 115 volts. There were originally six brush studs with four ½-in. x 1¼-in. (13-mm. x 32-mm.) brushes per stud. These brushes were changed to four ⅝-in. x 1¼-in. (22-mm. x 32-mm.) brushes so that one brush would cover approximately three bars of the commutator. After the change was made the motor was put back into service and has been operating satisfactorily ever since.

Bronx, N. Y. C. A. JOHNSON.

Cards for Recording Performance of Motor Brushes

FOR keeping, directly on the bins where brushes are stored, a record of the performance of motor brushes, the system described here has been found very successful in a New York printing shop. The records are kept on cards which may be inserted in clips on the drawers or bins. At the top of this card are recorded the size of the brush and the type of motor for which it is adopted. The marker's name and the grade of the brush are entered on a second line. With the number of each brush are tabulated the number of motor on which it is installed, the date of installation, the date of removal and remarks. To identify the brushes they are marked with numbers. On pigtail brushes the copper lug is stamped, while the number is scratched on the common type of brush.

By means of this system, if the life of the brush on

BRUSHES

Size_____ L._____ W._____ for_____

Makers name_____ Grade _____

Brush No.	Motor No.	Date		Remarks
		Installed	Removed	

CARD FOR RECORDING PERFORMANCE OF MOTOR BRUSHES

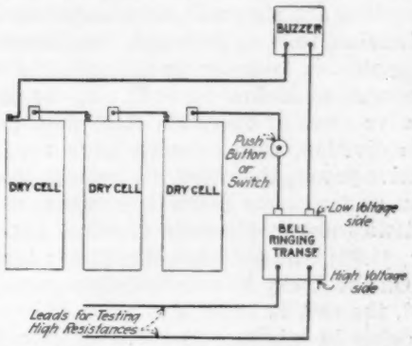
a motor is short, it is clearly shown by the card at the time the brush is removed. Moreover, if a new set of brushes has to be put on a motor, the type of brush to be used can be ascertained by looking at the card record. These cards are slipped into a bracket on the face of the drawer holding the different types of brush.

Each of these cards is large enough to record data on a number of brushes, and after the card is filled another card is slipped in front of it in the bracket.

New York City W. A. HARRIS.

Outfit to Test for Open High-Resistance Circuits

TO TEST the continuity of some high-resistance coils the writer recently employed a bell-ringing transformer, a buzzer and three dry cells. These were all connected in series (the low-voltage side of the transformer being used) with a push-button. The high-voltage side of the transformer was then connected to



OUTFIT TO DETERMINE IF A HIGH-RESISTANCE CIRCUIT IS OPEN

testing leads and these were applied to the high-resistance coils. The condition of the coils was determined by noting the different sounds of the buzzer when the push-button was pushed. For an open circuit the tone of the buzzer stays the same, but for a closed circuit the tone changes in accordance with the resistance of the coil. The high voltage generated by the transformer is sufficient for testing circuits of very high resistance.

As the outfit will test a very high resistance, several outfits of the same kind have been made up for use in the shop in place of magnetos. EUGENE TYLER,
Chief Electrician.

Massillon Bridge & Structural Company,
Massillon, Ohio.

Synchronous Motors for Mill Drives Said to Be Impracticable

ONE reason why a synchronous motor would not be satisfactory for a steel rolling-mill drive is because of the heavy starting conditions and the frequent necessity in case of a cobble to stop the motor and back the billet out of the mill. The starting torque of a synchronous motor would probably be entirely inadequate for such work.

While a synchronous motor would be very desirable as far as the effect on the power factor of the entire mill was concerned, the use of clutches to obtain such drive would not be satisfactory.

There is at the present time one such installation driving a brass rolling mill. There is in this case comparatively light starting duty, and peak loads are not a high percentage of the continuous capacity of the machine; so there is no tendency for the synchronous motor to fall out of step.

These points were brought out by J. D. Wright in a discussion of his paper "Electric Mill Drives," presented before the Philadelphia Section, Association of Iron and Steel Engineers.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Electric Energy Has Best of Steam Power

RELATIVE reliability and cost of steam and electrical operation are shown in a recapitulation issued by the Milwaukee railway in which the Missoula division of that system is taken as an example of conditions on the lines west of Mobridge, S. D. In the figures showing relative costs of operation it is shown that on the Missoula division, where electricity is used exclusively as a motive power, the outlay is from 25 to 45 per cent less than on the steam power operations, as the following statistics show: Missoula division, $1; Musselshell division, $1.90; Columbia division, $1.67; Idaho division, $1.90. On the Rocky Mountain division, also electrically operated, the cost is $1.11.

The delay in minutes per mile of line operated is much less on the Missoula division than on the three steam-operated divisions on the lines west, being two-thirds less than on the Avery-Cle Elum division, which until recently was steam operated.

Quarterly Billing of Residential Customers Proves Economical

QUARTERLY billing of residential customers has been the practice of the Philadelphia Electric Company for the past two years. Difficulty in obtaining and keeping efficient meter-reading and clerical forces was one of the chief reasons for the adoption of the plan, which applies only to residential and apartment-house customers. Of the company's 125,000 electric meters, 60,000 are classed as residential and are read quarterly.

Although many of the advantages are obvious it is impossible to tabulate the entire saving effected. Were the company to return to monthly meter reading it would be necessary to double its present force of meter readers. One particular advantage realized has been that with the decreased number of meter readers required the company could afford to maintain a higher personnel in this department. As fewer bills are rendered each month and the number of ledger entries is thus reduced the work has been arranged to make a substantial reduction in the number of clerks. There is also a very considerable saving in the matter of stationery, such as customers' bills and ledger pages.

In number of complaints received there has been no increase, but rather a decrease. When the plan was first put into effect there were naturally many who had paid no attention to the company's notices announcing the change. However, there was no difficulty in explaining the matter to the customers' satisfaction. Complaints on high bills have actually been fewer. Because of the bills covering a period of three months instead of one, as formerly, any unusual use of energy in one month is equalized by comparatively small consumption for the two other months. Losses through uncollectible bills have not increased, as the collection department, having fewer bills, can keep in closer touch with customers. In cases where satisfactory credit has not been established by customers larger deposits are required

Proper Merchandising Expenses Shown by Classification of Accounts

TO PLACE the new business departments of its subsidiary companies on a profit-making basis, the American Gas Company of Philadelphia four years ago adopted a merchandise accounting classification designed to include all proper charges against the cost of merchandising electrical appliances and supplies. This classification has proved very successful as it has made the merchandising and jobbing business profitable by enabling the new-business manager to ascertain just what it costs to conduct his department.

The classification is arranged to show separately the income from each of the following items: (1) Housewiring, (2) fixtures and appliances, (3) motors, (4) specials, (5) merchandise including miscellaneous supplies, lamps and portables. Against each of these are charged four items of expense—material, labor, vehicle and storeroom expense. The difference between the total income and total expense is shown as a net credit to electrical merchandise business. By thus showing the expense charged against each class of sales it is possible to tell where losses occur, and the method also prevents charging a lump expense to the total merchandise income.

The next charge, which would have to be carried by any mercantile business, is that of uncollectible bills. This is determined by taking one-twelfth of the total bad debts for merchandise of the previous year and charging this amount each month against the net credit to merchandise business. Discounts for cash payments and allowances are also charged against the net credit to merchandise business.

The balance after these charges is the profit from merchandising exclusive of new-business department and overhead expenses. The cost of operating the new-business department includes soliciting, demonstration, advertising, free wiring and appliances, supplies and incidental expenses. Deducting the total of these items from profit on merchandising leaves a credit to the new-business department.

Two other expenses which might well be termed "overhead" are, first, rent and interest on the money required to conduct the business; second, general office supervision. The amount of rent charged is not an arbitrary figure, but is determined by the rental paid by other businesses in similar locations. Interest on the money required to conduct the business naturally

varies with conditions. As a general rule the amount considered necessary would be the average total outstanding merchandise accounts plus all-merchandising and new-business expenses for two months. General office supervision is charged only if the general manager actually devotes part of his time to the supervision of the new-business department. After these charges have been made the amount remaining, if any, is the actual profit made by the new-business department from merchandising.

In compiling its schedule the American Gas Company endeavored to include such items of expense as would be incurred in any other merchandising business. Promotion and other expenses not strictly new-business or merchandising expenses are eliminated. Results have been highly satisfactory, and since the adoption of the classification the operations of the new-business departments have shown a profit instead of a deficit.

Data on Cost per Customer Served

TO SHOW the expense of serving individual customers in the twenty-two districts where it operates the Texas Power & Light Company compiles a comparative monthly statement giving the number of customers served in each district and the cost per customer. The following figures include the cost of distribution, municipal street lighting, local commercial expense and local general expense only per customer and do not include the cost of production, new-business expense, taxes, insurance, salaries and expense of the general office, or any expense not controlled by the manager:

Districts	No. of Customers	Cost per Customer
Denison	3,427	0.53
Sherman	2,709	0.54
Cleburne	2,734	0.56
Terrell	1,655	0.60
Tyler	1,886	0.64
Gainesville	1,616	0.75
Bonham	1,802	0.78
Hillsboro	2,499	0.80
Temple	3,856	0.80
Taylor	2,347	0.82
Palestine	1,698	0.84
McKinney	2,907	0.85
Waxahachie	2,424	0.85
Paris	2,877	0.87
Ennis	2,085	0.89
Commerce	1,320	0.93
Waco	6,517	1.07
Brownwood	2,826	1.11
Total	47,185	0.81
Sweetwater	1,399	1.13
Eagle Pass	1,071	1.42
Big Spring	648	1.65
Wichita Falls	6,634	1.70
Total	9,752	1.55
Grand total	56,937	0.95

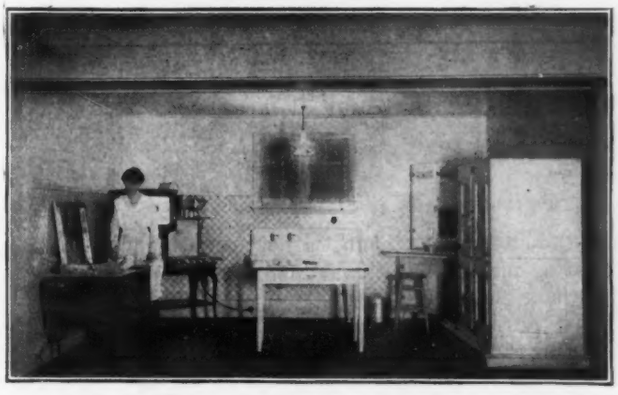
Providence (R. I.) Company Increases Power Rate

POWER customers of the Narragansett Electric Lighting Company, Providence, R. I., signing a contract for a demand of 200 kw. or more were recently interviewed by representatives of the company relative to an advance of about 15 per cent in rates. Under the new schedule there is a monthly service charge of $1.85 per kilowatt of demand for demands between 200 kw. and 300 kw.; $1.80 from 300 kw. to 500 kw.; $1.75 from 500 kw. to 750 kw.; $1.70 from 750 kw. to 1,000 kw.; $1.65 from 1,000 kw. to 1,500 kw., and $1.60 for 1,500 kw. and more. There is an additional charge of 1.2 cents per kilowatt-hour consumed. In the Providence suburban territory the energy charge is 1.3 cents. A fuel clause adjustment applies on these rates, as recently outlined in the ELECTRICAL WORLD.

Through a contract with the New England Power Company energy may be supplied to these large customers from the central New England hydro-electric system or from the steam-turbine plant of the Providence company as load and water conditions dictate. Before the rates went into effect on July 1 they were filed with the Rhode Island Public Utilities Commission, and as no opposition developed the new charges were automatically adopted. At a conference between Mayor Gainer, representatives of the Narragansett company and members of the City Council of Providence last month, it was pointed out that the new schedule affects only about twenty of the larger customers, most of whom agreed to the rate advance soon after its necessity was set forth. Under the new schedule energy may be used for motors, electrolytic processes, commercial heating apparatus, battery charging, welding and lighting not exceeding 25 per cent of the total demand.

Model Electric Kitchen and Laundry for Demonstrating Appliances

IN ITS electric shop at Tenth and Chestnut Streets the Philadelphia Electric Company has installed a complete electric kitchen and electric laundry, both of which are practical installations in every respect. The kitchen, as shown in the accompanying cut, is equipped



MODEL ELECTRIC KITCHEN OF PHILADELPHIA ELECTRIC COMPANY

with an automatic electric range, an automatic electric refrigerator and an electric dishwasher. In the laundry the equipment consists of an electric washer, an electric ironing machine and an electric iron of household size.

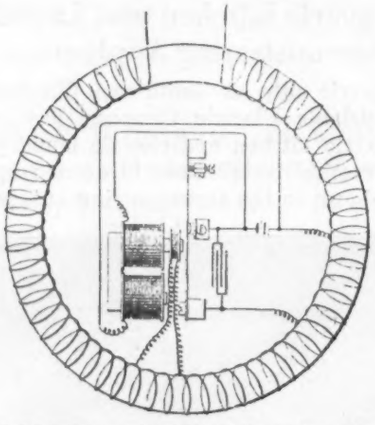
Practical demonstrations in the kitchen and laundry are carried on daily and prospective customers are invited to see the equipment in actual operation. Such demonstrations have been of considerable value in instructing customers in the proper use of appliances at the time they are purchased, thus preventing a great deal of unnecessary trouble that may be caused by the customer not thoroughly understanding the appliance.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Generators, Motors and Transformers

Mechanical Rectifiers.—A. SOULIER.—The idea of the mechanical rectifier is old. The classical generators of Brush and Thomson-Houston type were nothing but alternating-current machines provided with rotating commutator rectifiers. More refined devices are now used, operating, however, upon similar principles. They may be built either for single-phase or for three-phase supply. All such rectifiers must be kept in true synchronism, and the brushes must be so adjusted that they open the circuit at the exact moment when the output current passes through its zero value. An interesting type of mechanical rectifier is the oscillating rectifier which makes use of the synchronous motion of a steel tongue in the field of an alternating-current electromagnet. In order not to get a double-frequency oscillation, an initial direct-current excitation is used,



OSCILLATING RECTIFIER FOR CHARGING OF STORAGE BATTERIES

and the alternating magnetic field component is superposed by means of a smaller coupling coil, which is fed from a transformer. The action thus is similar to that of the voice currents in a Bell telephone receiver. In charging storage batteries the direct-current magnetization is taken from the battery itself, so that whatever the battery polarity happens to be, the rectifying tongue will always keep the right phase for charging. When the battery polarity is reversed, the magnetic excitation also is reversed, and thus the oscillating motion will take place in opposite phase, always permitting the correct current half wave to pass through the battery. The necessary phase adjustment is obtained by putting a condenser across the alternating-current input (see diagram), and this arrangement is said to work so quickly that no sparking whatever is to be detected. The contacts of one particular rectifier, after having been in use for seven years, showed no signs of deterioration or misadjustment. The oscillating rectifier gives up to 70 per cent efficiency on battery charging, but utilizes only every other half wave of the supply voltage. It was found that a double-acting rectifier gave lower efficiency, possibly because in the single-wave rectifier the minute hydrogen bubbles will stay on the electrodes during the idle periods and by chemical action cause a deeper penetration of the charge.—*Revue Générale d'Electricité*, May 8, 1920.

Lamps and Lighting

Artificial Daylight for Merchandising and Industry.—G. H. STICKNEY.—The great difficulty in approximating daylight by artificial means is owing mainly to the indefiniteness of the term daylight. Daylight, as it is generally known, is a combination of direct sunlight and reflected skylight and varies widely with the state of the atmosphere, etc. The closeness with which artificial light should approach average daylight varies for different purposes, and the requirements are arranged in three groups by the author. The needs of the silk dyer are most exacting and are closely followed by the requirements of the woolen industry. Other industries involving color matching come in the second classification, while the color matching needs of the merchants are the least exacting and form the third class. The quality of artificial lighting demanded by the first class is produced by expensive and inefficient color-matching units. A more efficient light source of lower color accuracy is provided by the "daylight" lamp. The author mentions specific applications where modified light can be employed.—*General Electric Review*, June, 1920.

Generation, Transmission and Distribution

Allowable Working Stresses in High-Voltage Electric Cables.—C. W. DAVIS and D. M. SIMONS.—It is stated that there is a general belief that the limiting feature in the operation of high-voltage cables is the maximum voltage stress and that if this stress exceeds a value of about 19.5 kv. per centimeter in commercial cables, as made today, the cable will fail in a relatively short time. The authors of this article have compiled extensive tables for both triplex and single conductor cables with paper, rubber and varnished-cambric insulations, which show much higher stresses than 19.5 kv. per centimeter in cables which have been in service for some time. The writers conclude, therefore, that this voltage limit is not the practical one.—*Electric Journal*, July 1920.

The Water-Power Plant at Gösgen, Switzerland.—In a profusely illustrated article, with installments appearing in almost every issue of the *Schweizerische Bauzeitung* for the first half-year 1920, the controlling company, Société Motor, publishes a detailed description of the recently completed hydro-electric plant at Gösgen, on the Aare, in Switzerland. By consolidation of earlier water rights the falls along a 14-km. (8.7-mile) stretch of the Aare are utilized, giving a total fall of from 14 m. to 17 m. (45 ft. to 56 ft.) at 300 cu.m. (10,000 cu.ft.) per second. Great emphasis is put on an accurate description of the hydraulic constructions including all auxiliaries, and various stages of the development are shown on photographs. It is interesting to

note that the first plant in this part of the Aare Valley, built in 1904, was provided with hydraulic storage consisting of a 12,000-cu.m. (423,000-cu.ft.) reservoir, the water being pumped by waste power during the night to this reservoir, which had an elevation of 320 m. (1,050 ft.). In this way the eight-hour capacity of the plant was increased from 2,500 hp. to 3,500 hp. In the present development a total of 45,000 hp. will be delivered by 6 vertical hydro-electric turbo-generator units.—*Schweizerische Bauzeitung*, January to May, 1920.

Traction

3,000-Volt Current Collectors.—W. SCHAAKE.—The writer describes a combination of a double-shoe type of pantagraph trolley and a twin-wire flexibly supported catenary overhead construction which has been developed for the Chicago, Milwaukee & St. Paul locomotives. He states that this arrangement has very effectually solved the problem of heavy current collection.—*Electrical Journal*, July 1920.

Installations, Systems and Appliances

Welded Steel Specials as a Substitute for Castings.—On account of the difficulty in getting large castings during a strike of ironmolders, it has been found possible to build up large pipe fittings, such as elbows, by means of steel plate suitably bent and welded together. It is said that the results were fully satisfactory.—London *Engineering*, May 28, 1920.

Durability of Electric Heaters for Gasoline Distillation.—W. A. JACOBS and E. W. DEAN.—A Bureau of Mines electric gasoline distillation heater and a commercial device sold for the same use have been subjected to life tests at maximum current load. Each failed at the end of approximately 500 hours, the bureau heater through deterioration of the resistance wire and the commercial heater through disintegration of the block of insulating material holding the resistance wire. The bureau heater has an inverted conical resistance element surrounded by a layer of heat-insulating material and mounted in a metal case having a top of hard asbestos (transite) board. The resistance element is a helix of nickel-chromium alloy wire held by a molded core of alundum. The commercial heater has a helix of nickel-chromium alloy wire resting in a spiral groove cut in a depression in a block of heat-insulating composition. The coils of wire are held in place by a special cross of sheet mica.—*Reports of Investigations, U. S. Bureau of Mines*, June 1920.

Electrophysics and Magnetism

Fundamental Phenomena in Electron Tubes Having Tungsten Cathodes, I.—IRVING LANGMUIR.—The phenomena upon which the operation of these tubes depends are so different from those of most electrical devices that confusion has frequently arisen as to the interpretation of their various characteristics, it is said. The author discusses the fundamental factors, such as the electron emission from the filament, the effect of space charge, the disturbances caused by the current passing through the filament, etc., and endeavors to clear up many of the mysterious effects that have been observed.—*General Electric Review*, June 1920.

110,000-Volt Transmission Line from Switzerland to France.—PAUL MEYER.—Up to 20,000 kw. may now be transmitted over a high-tension line 185 km. (115 miles) long from the hydro-electric power station at Gösgen, Switzerland, controlled by the Société Motor, to the substation at Pouxeux, in the Vosges, France. The line was constructed under the auspices of the French Ministry of War, which explains that necessary copper and other material for the line could be obtained in war time. The voltage is 110,000, but temporarily the line is used at 70,000 volts to enable immediate utilization of the power in the distribution systems of the Compagnie Lorraine d'Electricité. The conductors are of electrolytic copper, seven wires twisted, with an external diameter of about 11.5 mm. (0.5 in.) and a sectional area of 78 sq.mm. (154,600 circ.mil). The line is provided with a protecting ground wire of 8 mm. (9.315 in.) diameter and 40 sq.mm. (76,800 circ.mil) area, carried all along the line, on top of the masts. The insulators are metal-cap, eight-unit, chain type, with a dry flashover of more than 150,000 volts and a rain test of 45,000 volts per unit, the mechanical strength being 4,200 kg. (9,250 lb.) The poles are of steel structure, 19.7 m. (64.6 ft.) high and with a standard spacing of 180 m. (591 ft.), which gives a 7-m. (23-ft.) clearance from lowest wire to ground at 35 deg. C. (77 deg. Fahr.). The line was built by the Compagnie Générale d'Electricité on principles similar to those of American practice. Special protective structures are provided at railroad crossings, but, contrary to European usage, telephone crossings are not protected by grounded cages, although at places two insulator chains are used in parallel to give greater safety. The article is profusely illustrated and gives full details regarding the design and construction of the line.—*Revue Générale d'Electricité*, May 1, 1920.

Telegraphy, Telephony and Signals

Telephone from Stockholm to Berlin.—A. HOLMGREN.—Just before the outbreak of the war commercial telephone traffic was established between Stockholm and Berlin. Connections were made over Denmark, and communication took place only between special pay stations provided with Egner-Holmstrom high-current microphones. Recently a new route has been opened, via a direct submarine cable in the Baltic, and connections now are made between subscribers' telephones as far north as Stockholm and Christiania and as far south as Berlin and Frankfort. The cable is of a two-pair paper-insulated type with lead cover and is continually loaded according to the Krarup system. It has a damping of about 1.6. Vacuum-tube amplifiers are used in Malmö and Stralsund. The common telephone-repeater circuits are shown in the article, and an interesting method of designing balancing networks is also described.—*Teknisk Tidskrift, Elektroteknik*, March 3, 1920.

Units, Measurements and Instruments

A Direct-Reading Voltmeter.—ABRAHAM E. BLOCH and L. BLOCH.—Under the auspices of the French Military radio-telegraphy authorities an amplifying voltmeter has been developed which has a remarkably wide field of application, the readings being practically independent of frequency. The instrument works as a multistage amplifier, the last tube also acting as a rectifier and being connected to a direct-current milliammeter. A potential difference of 1 millivolt may easily be observed, and since the voltmeter system has an input impedance of 100,000 ohms, this corresponds to an instrument loss of only ten millionths of a microwatt. A number of interesting applications of the instrument suggest themselves, such as the direct comparison of impedances at radio frequency, etc.—*Bulletin de la Société Française des Electriciens*, January, 1920.

DESPITE the dullness incident to midsummer a good volume of electrical sales is still reported in the East. In the Middle West and on the Pacific Coast sales are slowing up. In the South the heavy building movement has caused a brisk demand to continue.

IMPROVEMENT in the freight situation is reported, though the Atlanta territory is suffering from a car shortage which is holding up the supply of building material. The movement of wheat is now a factor which has to be reckoned with in canvassing the transportation problem.

LABOR is fairly steady. Collections are becoming tight all over the country, but construction reports are encouraging on the whole and an optimistic feeling prevails.

ACTIVITY in the transformer market is reported, power and distribution transformers being sought in about the usual proportions. The new water-power act has opened the door to larger future sales.

ARC-LAMP sales for municipal street-lighting service, which have picked up considerably since war time, are 75 per cent ahead of last year's record, with deliveries at from two to three months.

TRANSFORMERS exported from the United States during 1919 amounted in value to $3,787,851. For the first five months of 1920 they reached $1,482,712, or below last year's figures for the same period.

DEMAND for high-tension insulators has increased to such an extent that it now far outstrips available supply, notwithstanding that production is nearly or quite up to normal.

INCREASED station output from interconnection of the Central Maine Power Company's lines with the Brunswick station of the Bath & Brunswick Light & Power Company reached more than 300 per cent in four years.

RAILROAD electrification, hogged fuel and power-factor correction were extensively discussed at the last two days' session of the convention of the Pacific Coast Section, A. I. E. E., at Portland, Ore.

PROF. ELIHU THOMSON, speaking before the Executive Club of the Lynn works, General Electric Company, expressed the belief that the development of radio-telegraphy and radio-telephony will reach such a state of perfection in time that persons in all parts of the world will be able to converse with ease.

SPOT coal is costing New York City utilities $7,000,000 additional a year, according to testimony before a Senate investigating committee. Attorney-General Palmer is taking steps to end profiteering, and a committee representing the public, the railroads, consumers and wholesalers has been appointed to aid him. The Interstate Commerce Commission has granted for New England a priority order similar to that previously made for the Northwest.

News in Brief

Summary of Market Conditions and of Recent and Approaching Happenings of Importance to the Industry

THE CONVENTION of the Illuminating Engineering Society has been postponed one week and will be held in Cleveland on Oct. 4 to Oct. 7.

THREE more electric utility issues, totaling $4,900,000, are announced, to yield from 7½ to 8.1 per cent.

A POLICY of centralized coal purchasing has been adopted by the Doherty companies.

SHORTAGE of power in Detroit has led to the appointment of a consumers' committee to allot energy to consumers.

RADIO-TELEPHONIC communication between St. Johns, Newfoundland, and a ship 600 miles out has followed on the heels of the establishment of the first commercial radio-telephone service, between the Bell system and the Catalina Islands.

AN ELECTION in Greensboro, N. C., on granting a charter to the Southern Power Company to compete with the North Carolina Public Service Company, now serving that community, resulted in the defeat of the proposition by 990 to 78.

NEW SUBSTATIONS are to be built by the Kansas City Light & Power Company with the object of bringing its generating equipment closer to its load center, and one large substation now in use will be abandoned.

JOHN S. RILLING, a member of the Pennsylvania Public Service Commission, dissenting from an order of that body fixing rates, declared that 7 per cent is no longer a sufficient return for a utility.

AFFILIATION with the Great Lakes Division of the N. E. L. A. has been voted by the Illinois State Electrical Association.

EXPORTS of bituminous coal in the first half of 1920 reached 8,668,000 tons, according to the figures of the Geological Survey. For the month of June exports were 2,175,000 tons, or more than three times the monthly average for 1919.

AN EXTENSION of the Concord (Mass.) municipal lighting plant, to cost $50,000, has been voted in preference to purchasing central-station energy under present conditions of underground-line construction cost.

AGITATION on behalf of the state development and public ownership of water powers in Maine has become virtually a dead issue for the time being. Increasing interest in customer ownership of public utility stocks has improved the situation, to the advantage of the public and existing companies.

OF A BOND issue totaling $1,500,000 the Western States Gas & Electrci Company has placed $200,000 at 96, bringing a yield of 8 per cent.

THE SCHEDULE of fall and winter meetings for the Technical Section of the N. E. L. A. has been completed. It embraces thirty-two committee meetings, divided among its seven technical committees, besides the executive committee meeting.

TWO DIVISION engineers have been appointed by W. S. Murray to assist him as head of the engineering staff of the super-power zone project and a third will soon be designated. Additional advisory board appointments have also been made.

CALVIN COOLIDGE in his speech accepting the Republican nomination for the Vice-Presidency declared for needed development of water-power and other natural resources, but warned against permitting speculation in them.

SUBSTANTIAL rate increases have been granted to West Virginia electric companies by the Public Service Commisison of the state.

REFUSAL by the city authorities of Blackfoot, Idaho, to pay the 10 per cent increase granted by the Public Utilities Commission of the state to the Idaho Power Company has paved the way for a test of the commission's power.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Federal Power Commission Agrees on Organization

THE NATIONAL ORGANIZATION of the Federal Power Commission was agreed upon at a meeting of the commission July 27. It is to be composed of the following subdivisions: Engineering, accounting, statistical, regulating, licensing, legal and operation. The duties of the executive secretary and the engineer officer were outlined in detail for administrative purposes. The country has been divided into five districts with headquarters as follows: No. 1, Washington; No. 2, St. Paul; No. 3, St. Louis; No. 4, Denver; No. 5, San Francisco. Branch offices will be maintained in each district.

The return to Washington of Secretary Meredith is expected to be followed very soon by increased activity on the part of the Federal Power Commission. A number of important matters necessarily have been held in abeyance until the secretary can join in their decision. Great care is being exercised in deciding on the wording to be used in the form of application. It is realized that this is one of the most important of the documents which it will be necessary to draw up.

Attorney-General Takes Steps to End Coal Profiteering

ATTORNEY-GENERAL PALMER was in New York Tuesday conferring with representatives of producers, dealers and consumers of bituminous coal in an effort to check profiteering. A committee was selected by Mr. Palmer representative of the public, the railroads, consumers and wholesale dealers, with the producers' representatives to be named later. John W. Lieb, vice-president of the New York Edison Company, was selected to represent the consumers. A statement issued later by this committee was to the effect that it had not been asked to fix prices but rather to ascertain a maximum margin of reasonable profit beyond which prosecutions under the Lever act will be commenced by the Attorney-General's office.

One of the results which the committee hopes will follow, in addition to a material reduction in bituminous coal prices, is a larger percentage of deliveries under contract prices with a subsequent reduction in spot coal offerings.

Another Step Toward Transoceanic Radio Telephony

ON THE heels of the announcement that the first commercial radio-telephone service had been established, from the Bell System to the Catalina Islands, comes the record of telephonic communication between the Marconi radio plant at St. Johns, Newfoundland, and the steamer Victorian, about 600 miles (1,000 km.) at sea. A phonographic concert on shipboard was plainly heard by those near the receiver at St. Johns.

While the St. Johns test involved the use of special apparatus and the results cannot yet be repeated on a commercial basis, it marks an important advance in the art, and it is believed by radio engineers that such communication will soon be commercially practicable. The good results in this instance are attributed to the use of vacuum tubes of higher power. It is worthy of note, however, that the transmission of speech over 600 miles was in the summer time, when atmospheric conditions are least satisfactory.

Regarding the extension of telephone service to the Catalina Islands by the American Telephone & Telegraph Company, 30 miles (50 km.) of which are by radio, it is said that conversation is no more difficult than over any other long-distance line and that it is not evident to those conversing that there is a gap.

Spot Coal Costing New York Utilities an Additional $7,000,000 a Year

NEW YORK CITY utilities, it was testified last week before the Senate committee on reconstruction and production, of which Senator William M. Calder is chairman, unable to obtain coal on contracts, have been forced to buy in the open market at an additional cost of more than $7,000,000 a year.

John W. Lieb, vice-president of the New York Edison Company, told the committee that the Edison company and its affiliated companies had contracts for 1,535,443 tons of coal, but that since April 1 they had received only 52 per cent of the amount their contracted deliveries called for. The average daily consumption he estimated at about 4,000 tons. The company has storage yards at Edgewater with a capacity of 250,000 tons. By this date in normal times the reserve has been built up to about 200,000 tons. The peak of storage is reached about Oct. 1, but instead of mounting toward that peak, he said, the reserve had been dwindling until there is practically none. The company now has a reserve of 49,981 tons, largely because it had gone into the open market and bought spot coal.

Mr. Lieb said the company for the first time in its existence had had to get 35,000 tons at Hampton Roads and bring it to New York at a cost of more than $12 a ton. Even with coal arriving in New York in sufficient volume to allow 4,000 tons for immediate use, the situation, when cold weather comes, will be acute. Mr. Lieb said the daily receipts now should be 5,800 tons to enable the company to build up its winter reserve.

Speaking as of June 26, Mr. Lieb said that prices of spot coal ranged from $7.50 to $10.25 a ton, but that more recently it had sold as high as $12 at the mines. Ordinary prices, he testified, run between $4.25 and $4.75 at the mines.

Senator Calder is planning to hold similar meetings of this committee on the coal question in various other important centers of the country.

Consumers' Committee Allots Energy to Power Users in Detroit

THERE has been an acute shortage of power in Detroit for some time, and the Detroit Edison Company has had to ask its factory customers to cut down their power requirements wherever possible. Within the past month the company carried a peak load of 218,000 kw., which is considerably in excess of the total installed capacity of its plants. It has now become necessary to take a 45,000-kw. unit out of service to await new parts not yet completed by the manufacturer. This has decreased the available generating capacity by about 20 per cent and necessitated a still further curtailment of the use of energy by all large users.

To handle this situation a committee of five, made up of representatives from the power users and the Chamber of Commerce, has been formed. This committee determines how much energy each factory may take and also designates the hours of the day during which power shall be used. Commenting on the situation, Alex Dow, president and general manager of the Detroit Edison Company, stated to a representative of the ELECTRICAL WORLD that the work of the committee in allotting power to approximately a hundred large users had been carried out more satisfactorily than could have been done by the company. The committee was able to deal impartially with all consumers and succeeded in adjusting the morning peak load to 156,000 kw. as compared to the recent peak of 218,000 kw.

New England Gets Coal Priority Order

THE Interstate Commerce Commission this week ordered, effective on Monday, Aug. 2, coal priority for New England similar to that ordered ten days previously for the Northwest. The object of the order is the filling of the fuel requirements of New England for the summer and following winter months. The coal is to be moved from Pennsylvania, Maryland, Virginia and West Virginia mines to tidewater pools, from which coal may be shipped out for use in New England. This is taken to mean a virtual embargo against the export of coal, which in recent months has reached record totals.

This order, however, is not to interfere with the priority recently granted to public utilities.

Record Coal Exports in June

IN VIEW of the coal shortage that has been so generally felt by utilities and others in the past three months, the figures made public this week by the Geological Survey showing the exports of coal during the first six months of 1920 are of great interest. The exports have been increasing, and in June last, when the shortage began to be so acute as to warrant the famous open-top car order of the Interstate Commerce Commission, the exports of bituminous coal reached a record of 2,175,000 net tons. If statistics were available, it would probably be found that this figure is not far different from the amount of bituminous coal used in the electric light and power industry during June.

The figure might well be compared with the monthly average for 1918 of 312,000 tons and the monthly average for 1919 of 691,000 tons. Up to July 1 8,668,000 tons of bituminous coal had been exported in 1920, the monthly figures being: January, 897,000 tons; February, 718,000 tons; March, 1,033,000 tons; April, 1,093,000 tons; May, 1,942,000 tons, and June, 2,175,000 tons.

Doherty Properties Adopt Centralized Coal Purchasing Plan

PURCHASING coal and following up its delivery under existing conditions has required so much of the time of the managers of the Doherty Ohio properties that they have arranged for the handling of all their coal requirements through a centralized department. For this purpose the coal buying organization of the Toledo Railway & Light Company will be expanded. R. E. Connolly, who in the past has had charge of the coal purchases for the Toledo and Acme companies, will be in charge of the work in the field.

The companies affected are the Toledo Railway & Light Company and the Acme Power Company in Toledo, Richland Public Service Company in Mansfield, Massillon Electric & Gas Company, Alliance Gas & Power Company and the Trumbull Public Service Company at Warren, Ohio.

I. E. S. Convention Postponed to October 4-7

BECAUSE the American Legion is to hold its convention in Cleveland during the last week in September the Illuminating Engineering Society has postponed the date for its annual convention one week, to Oct. 4-7. The program is in the hands of Preston S. Millar of the Electrical Testing Laboratories, who expects to be able to make a preliminary announcement early in August. The convention committees have been appointed and a number of papers have already been received.

Adirondack Power Merger Completed

CONSOLIDATION of the former Mohawk-Edison company and the Adirondack Electric Power Corporation into the Adirondack Power & Light Corporation was completed July 23 in conformity with orders of the Public Service Commission of New York. The merged properties operate 300 miles of interconnected transmision line in New York State, extending from Glens Falls south to Schenectady and Albany and west to Oneida. At the present time the company has in operation twenty-one substations, 43,340 kw. in hydro-electric and 6,750 kw. in steam generating plants and will shortly commence the construction of a new hydro-electric plant of 27,500 kw. on the Mohawk River near Amsterdam, N.Y. The aggregate gross income of the consolidated companies for the past year was $4,139,975.

Three More Utility Issues, Totaling $4,900,000

SINCE last week three more issues of electric light and power utility securities have come on the market, totaling $4,900,000. The West Penn Power Company's $3,000,000 of first mortgage 7 per cent bonds, due 1946, are being sold at 94¼, yielding 7½ per cent. The Continental Gas & Electric Corporation is issuing $1,400,000 of two-year collateral trust 7 per cent notes at 98, yielding 8.1 per cent, and the Cincinnati Gas & Electric Company has issued $500,000 of 7 per cent notes, due 1922, at 97¾, yielding 8 per cent.

N. E. L. A. Technical Section Meetings

THE schedule of meetings of the Technical Section of the National Electric Light Association has just been completed and is as follows:

Date	Committee	Meeting Place
1920		
Sept. 11	Hydraulic power	Spokane, Wash.
Sept. 20	Meters	Chicago, Ill.
Sept. 20	Prime movers	Chicago, Ill.
Sept. 20	Underground systems	Detroit, Mich.
Sept. 21	Inductive interference	Chicago, Ill.
Sept. 21	Meters	Chicago, Ill.
Sept. 22	Electrical apparatus	Chicago, Ill.
Sept. 22	Overhead systems	Chicago, Ill.
Sept. 23	Overhead systems	Chicago, Ill.
Oct. 18	Prime movers	Philadelphia, Pa.
Nov. 11	Underground systems	Pittsburgh, Pa.
Nov. 15	Inductive interference	Salt Lake City, Utah
Nov. 15	Prime movers	Salt Lake City, Utah
Nov. 16	Meters	Salt Lake City, Utah
Nov. 16	Overhead systems	Salt Lake City, Utah
Nov. 17	Electrical apparatus	Salt Lake City, Utah
Nov. 17	Meters	Salt Lake City, Utah
Nov. 17	Overhead systems	Salt Lake City, Utah
Nov. 18	Hydraulic power	Salt Lake City, Utah
Dec. 7	Meters	Buffalo, N. Y.
Dec. 8	Meters	Buffalo, N. Y.
Dec. 9	Meters	Buffalo, N. Y.
1921		
Jan. 17	Hydraulic power	New York City
Jan. 17	Underground systems	New York City
Jan. 18	Inductive interference	New York City
Jan. 18	Meters	New York City
Jan. 18	Prime movers	New York City
Jan. 19	Electrical apparatus	New York City
Jan. 19	Meters	New York City
Jan. 19	Overhead systems	New York City
Jan. 19	Executive	New York City
Jan. 20	Overhead systems	New York City
Feb. 21	Prime movers	Schenectady, N. Y.

All technical committee meetings will start promptly at 10 a.m., and the executive committee meeting will be held in the evening, at the call of the chairman of the Technical Section.

Super-Power Zone Engineering Staff Almost Completed

A GENERAL discussion of the problems involved characterized the first meeting of the super-power zone engineering staff, which took place at the Geological Survey's New York office July 23. In addition to members of the engineering staff, the meeting was attended by George Otis Smith, the director of the Geological Survey, and N. C. Grover, the Survey's chief hydraulic engineer. Considerable attention was given to the type of data sheets which will be used.

W. S. Murray, head of the engineering staff, has announced the appointment of two division engineers, and the third probably will be designated within a few days. Those selected are Lorin E. Imlay and Henry W. Butler. Mr. Imlay will have charge of the power transmission division and Mr. Butler will be division engineer of industries. Henry Flood, Jr., has been selected as the engineer secretary of the engineering staff. Harold Goodwin has been appointed assistant industries engineer and L. A. Whitsit assistant power transmission engineer.

Additional appointments to the advisory board are announced as follows: J. B. McCall, representing the National Electric Light Association; John H. Pardee, representing the American Electric Railway Association, and A. T. Hardin, vice-president of operation of the New York Central Railroad, representing the New York railroads.

The work of the engineering staff is now in the formative process of determining the most condensed form of data sheets to be taken up with the central stations, isolated plants and railroads to determine their power-load curves and the direct allocation of load centers relating to the three above interests for the purpose of determining the cost of power production as between an interconnected super-power system and the present individual systems.

The basic principle of the investigation and report is to be a clear-cut statement as to (1) total fuel conservation, (2) the adequate supply of generating capacity to permit normal growth of industries and transportation, and (3) a guarantee of reliability of power service to consumers.

Coolidge Comes Out Against Water-Power Grants for Speculation

IN HIS speech of acceptance of the Republican vice-presidential nomination this week Calvin Coolidge told of the need for conservation of natural resources which will permit development in the public interest. He warns, however, against the use of public grants for private speculation. In this connection he said:

"Diminishing resources warn us of the necessity of conservation. The public domain is the property of the public. It is held in trust for present and future generations. The material resources of our country are great, very great, but they are not inexhaustible. They are becoming more and more valuable and more and more necessary to the public welfare.

"It is not wise either to withhold water power, reservoir sites and mineral deposits from development or to deny a reasonable profit to such operations. But these natural resources are not to be turned over to speculation to the detriment of the public. Such a policy would soon remove these resources from public control and the result would be that soon the people would be paying tribute to private greed. Conservation does not desire to retard development. It permits it and encourages it. It is a desire honestly to administer the public domain. The time has passed for private speculation."

Interconnection More Than Triples Output of Plant

INCREASED output resulted from the interconnection of the Central Maine Power Company's lines with the Brunswick station of the old Bath & Brunswick Light & Power Company, according to a statement made by W. S. Wyman, treasurer and general manager of the former company, at a recent hearing before the Maine Public Utilities Commission. In 1915 the Brunswick plant produced about 2,500,000 kw.-hr.

"We expected," said Mr. Wyman, "to get 5,000,000 kw.-hr. out of this station after connecting it with our system, owing to the better load factor. Actually we obtained in 1919 8,000,000 kw.-hr. from that station.

Mr. Wyman pointed out that at Lewiston the Deer Rips plant of the former Androscoggin Electric company is using about 18,000,000 kw.-hr. from a 30-ft. (9-m.) head, and that when this station is interconnected with the Central Maine system by a new trunk line now under construction from Farmingdale to Deer Rips the plant will be able to deliver about 50,000,000 kw.-hr. if the load conditions on the combined systems are favorable. A similar situation exists at Skowhegan, where a 32-ft. (9.6-m) head is being developed on the Kennebec River. The average flow there closely resembles that of the Androscoggin at Deer Rips. An 8,000-kw. steam auxiliary station of the oil-burning type at Farmingdale is expected to suffice for the combined systems, with a 1,500-kw. reserve plant at Lewiston.

West Virginia Electric Companies Get Increase in Rates

AN INCREASE of 30 per cent in rates has been granted to the Appalachian Power Company by the Public Service Commission of West Virginia to continue until May, 1921. This company serves Bluefield and other West Virginia towns as well as supplying mining and other companies in its territory. The commission also authorized the Princeton Power Company to charge $1.56 a kilowatt-hour. To the Wheeling Electric Company it granted the right to add a surcharge of 27 per cent to its monthly bills from July 1 to Oct. 31, pending investigation by the commission.

Railroad Electrification and Hogged Fuel Discussed by Pacific A. I. E. E.

A PAPER on "Electrification of Railroads," by R. Beeuwkes of Seattle, chief electrical engineer of the Chicago, Milwaukee & St. Paul Railway, was a feature of the second day's session of the Pacific Coast Section, American Institute of Electrical Engineers, at Portland, Ore., of which the opening meetings, on Wednesday, July 21, were reported last week. Instructive papers on hogged fuel, on bridge measurements of alternating currents and on power-factor correction were also presented at the convention, which closed on Friday, July 23.

In the discussion of Mr. Beeuwkes' paper the opinion was expressed that there is at present no basis for standardization of voltage. W. J. Davis believed each case should be determined upon its own merits. On single-track lines 3,000 volts is the most economical, he held; for two-track lines, 1,500 volts, and for four-track lines, 750 volts. These voltages are such that doubling or quadrupling the track would permit of the equipment being readily cut over for lower voltages. There appears no real necessity for standardization as between different roads, according to views expressed, although locomotives are capable of running nearly 1,000 miles without stopping. Mr. Beeuwkes stated that the cost of an increase in voltage from 3,000 to 5,000 would be greater than the increased cost of feeder copper for handling 5,000-ton trains.

Opinion was unanimous that railroads should purchase power from power companies because more feed points would thus be obtainable.

Ownership of transmission lines paralleling track should be vested in the railroad, Mr. Beeuwkes contended, because the trolley maintenance crews could maintain transmission lines at minimum additional expense. Arthur C. Pratt of the Montana Power Company agreed with this contention, but thought a power company should have the use of the lines for tying its own stations together and for supplying other consumers. Railway transmission lines should not take the place of transmission buses, in the opinion of R. F. Hayward of Vancouver, B. C. A further argument for ownership of transmission lines by the railroad is that the control of switching is thereby kept by the railroad.

It was brought out that without load-limiting devices on the Chicago, Milwaukee & St. Paul road the instantaneous demand would be 50 per cent above the limited value. The limit is determined by the point of greatest economy, considering the slowing up of trains and the extra expense due to increased trainmen's wages as against the higher cost of power at lower load factors. Regeneration has, it was asserted, returned 10 per cent of the power to the line. Auxiliary equipment consumes a portion of this regenerated power.

According to J. C. Clarke, electrification will postpone double-tracking ten to fifteen years, and interest on second track for that period would overbalance the cost of electrification.

Mr. Beeuwkes stated that six months' operation on one division caused a power expense of $113,000 against $270,000 for fuel. Any road, he said, could exactly calculate the possible savings under any given condition. The cost of trainmen and enginemen with electric equipment was $48,000 in six months, and the cost with steam was $85,000. Repairs for steam locomotives cost double those for the electric. Automatic substations have been investigated and will be installed on the C., M. & St. P., thereby further reducing cost.

"Hogged Fuel, Fuel Oil and Pulverized Coal" was the topic of a paper by Darrah Corbet. As yet hogged fuel is not sufficiently reliable to be used exclusively, according to L. T. Merwin, general superintendent of the Northwestern Electric Company, Portland. Many interruptions of fuel supply within the plant are due to breakage of the conveyor system, so the Northwestern company maintains heated oil under pressure for quick change-over, which can be effected in two minutes. Oil burned in hogged-fuel furnaces gives lower efficiency than oil in oil furnaces, Mr. Merwin said.

J. H. Polphemus, general manager of the port of Portland, stated that hogged fuel caused $3,000 monthly savings on a dredge and that there was 10,000 lb. (4,500 kg.) evaporation per fuel unit or seven pounds evaporation per hour per square foot heating surface (0.29 kg. per sq.m.). The opinion was expressed by Messrs. Merwin and Corbet that short straight grate bars are preferable to any others and that no difficulty would result from distortion provided there were sufficient supports. The ash pit could be flooded to reduce the temperature of the lower surface of grates. Stokers are too expensive at present prices of fuel.

Mr. Corbet was of the opinion that the wood-moisture content was independent of climatic conditions and entirely dependent on the kind of wood and its treatment before hogging. He thought some moisture was preferable, as extremely dry wood flashed in the furnaces and also introduced an undesirable hazard in storage. A mixture of wet fuel with refuse from kiln-dried wood gives the best firing results.

Japan Is Soon to Have a 160-Kv. Transmission Line

A 140-MILE transmission line between Seto and Osaka, Japan, now under construction, will be operated at 160,000 volts, three-phase, 60 cycles, with neutral grounded through resistance. This is part of an extensive hydro-electric development program involving an ultimate capacity of 200,000 kw. and transmission lines totaling more than 400 miles in length. The project is being undertaken in three successive steps of 30,000 kw. for the first, 70,000 kw. for the second and 100,000 kw. for the third development. All of the power plants will be operated eventually in parallel over two circuits on a single steel-tower line having a capacity of 100,000 kw.

The first development now under way is the construction of two plants, one of 9,000 kw. at Mosegawa and one of 19,000 kw. at Seto.

Chicago Electrical Men Effect Wage Settlement

THE strike on the surface car lines of Chicago which began without warning on Thursday morning, July 15, ended as abruptly on Sunday, July 18, after demoralizing the surface car service completely for one day and partially for three days and threatening strikes that would have affected the city lighting service and industrial plants. The city electrical inspection service was affected by a demand for an increase of $500 per year for forty-three electrical inspectors and $300 per year for twenty-three maintenance men. It was announced that these demands were met, but that when the money already appropriated was spent the men would have to be laid off, though this would not occur until Nov. 15. Action by the city finance committee approving the new rates must be taken before they are effective. In the street-car settlement line foremen get the rate offered by the company of $10 per day, $9 is to be paid to linemen and $7 to helpers, while substation men will receive $120 per month for the first year, $125 for the second, $130 the third and $145 the fourth. Operators will get $210 and $200, the figures offered by the company. Union demands were $225.

Greensboro, N. C., Stands by Its Local Electric Company

AN INTERESTING instance of popular support for an established public utility company is reported from Greensboro, N. C., where at a recent election a franchise sought by a competing company was refused by a vote of 990 to 78. The company which received this signal mark of confidence is the North Carolina Public Service Company. Between this company and the Southern Power Company, from which it purchases energy, a dispute over rates exists which is now awaiting determination in the Superior Court. The local company charges the Southern Power Company with discrimination, and the power company as part of its legal fight sought the Greensboro franchise.

According to R. J. Hole, vice-president and general manager of the North Carolina Public Service Company, the citizens of Greensboro, scorning any possible financial saving that the entry of the larger company might bring, rallied to the support of their local utility. Merchants, professional men, labor unions, the colored clergymen and others of influence made public declarations in its favor, and the result was the overwhelming victory above recounted.

Powers of State Commission to Modify City Franchise

RESTRICTIONS imposed by the public utilities law on the powers of the cities of Utah to control by franchise utilities operating within their boundaries were defined by the Supreme Court of Utah in deciding the case of Murray City against the Utah Light & Traction Company and the Utah Power & Light Company. The suit was brought by Murray City to test the legality of a ruling of the Public Utilities Commission in violation of the rate provisions of the franchise granted by the city to the traction company. It was appealed from the district court to the Supreme Court. That body upholds the district court, pointing out that in a Salt Lake City case against the same company it held that the state retained the power to modify or annul a charge for services rendered by a public utility and that any such order made by the commission is binding. The court explicitly refrains from expressing any opinion on the right of the city to cancel the franchise for failure on the part of the company to comply with other of its provisions, that question not being before it.

Michigan Section, N. E. L. A., Arranges a Diversified Program

THE tentative program for the seventh annual convention of the Michigan Section of the National Electric Light Association, which will be held on Aug. 24 to Aug. 26 at Ottawa Beach, Mich., is as follows:

Tuesday, Aug. 24, 10 a.m.—President's address, W. M. Lewis; "Legislation," by W. M. Smith, chairman Michigan Public Utilities Commission; address by M. J. Insull, president N. E. L. A.; "The Future of the Public Utility," by M. H. Aylesworth, executive manager N. E. L. A.; address by B. J. Mallaney, Illinois Committee on Public Utility Information.

2 p.m.—"Proper Maintenance of Electric Meters," by J. C. Langdell, Consumers' Power Company; "Standardized Construction," by B. L. Huff, Consumers' Power Company; "Boiler-Room Efficiency," by R. C. Felger, Detroit Edison Company.

8 p.m.—Illustrated talk, "Journeys in Cloudland," by M. Luckiesh, National Lamp Works Laboratories.

Wednesday, Aug. 25, 10 a.m.—"Home Rule Versus State Control," by W. J. Hagenah; "Light in the Home," by M. Luckiesh; "Standardization and Application of Electric Equipment as Applied to Farms," by Prof. A. R. Sawyer, Michigan Agricultural College; "Dishwashers and Other Labor-Saving Devices," by C. H. Bay, Detroit Edison Company.

Thursday, Aug. 26, 10 a.m.—"Machine Billing and Ledger Posting," by C. H. Hunsburger, Consumers' Power Company; discussion by J. D. Jacobus, Detroit Edison Company; "The Value of Statistics," by H. A. Snow, Detroit Edison Company.

Entertainment features have been arranged for Tuesday and Wednesday afternoons, and on Wednesday evening there will be a dinner, with an address on "Publicity" by J. B. Wootan of New York City.

Kansas City Company to Build New Substations as Measure of Economy

IN ORDER to insure a better distribution of power and obviate the present heavy transmission losses, the Kansas City (Mo.) Light & Power Company is about to begin work on plans to bring its generating system near its main load, instead of having it at one end of the system as heretofore. With this economical end in view it will expend approximately $500,000 in the next two years in the installation of five new substations in the downtown district between Oak and Wyandotte and Seventh and Fifteenth Streets. The big substation at Fifteenth and Walnut Streets is to be abandoned as facilities for operation under the new substation scheme develop.

The stations will be equipped with automatic motor-generator sets. The company has already purchased one 2,500-kw. rotary converter and a standard 1,500-kw. rotary is to be used in the R. A. Long station. The equipment in use at the Fifteenth Street substation has been 23-cycle; the new substation will be designed for 60 cycles.

Pacific Gas & Electric Sells $10,000,000 of Gold Notes.—It is announced that the issue of $10,000,000 in five-year 7 per cent convertible gold notes of the Pacific Gas & Electric Company has been entirely disposed of, more than $7,000,000 being taken in California.

A Radio Relay Test.—A wireless message was recently sent from Dubuque, Iowa, to Minneapolis, Minn., by a circuitous route involving its relay through twenty-six stations in five states, the total distance thus covered being 3,000 miles. The time taken was two hours.

Railroad Electrification in Japan.—A bill has been introduced into the Japanese Parliament intended to bring about the conversion of steam railroads to electric motive power. It is proposed to organize the Imperial Electric Railroad Company with a capital of $50,000,000, of which one-half will be invested by the government.

Water-Power Resources of Greece.—A syndicate of Greek banks in association with French investors is about to conduct an extended investigation into the hydro-electric possibilities of Greece. The syndicate will be financed by the Greek government, which, though it is not bound to accept the proposals made by the investigators, is thoroughly committed to the policy of water-power development.

Flat-Rate Charges Arouse Protest in British City.—The Corporation of Sheffield, England, has recently adopted a flat-rate system of charges for electricity which has naturally called forth vigorous opposition in that city of manufacturers. The assertion is made that if the users of power have to pay the same rates as lighting customers, orders for electrification of factories will be canceled and use of the city's energy largely discontinued.

Increase Allowed to Atlantic Coast Company.—The New Jersey Board of Public Utilities has granted to the Atlantic Coast Electric Light Company an increase of its base rate in Asbury Park, N. J., and contiguous places from 10 cents to 12 cents a kilowatt-hour, which the board says is virtually a return to a former rate and not excessive. It has also permitted the company to make a connection charge of $3 for each customer, which is to be refunded if the customer remains at the shore more than six months.

Electricity Barred from California Mines.—Yielding to the protests of many farmers in the lower part of Nevada County, Cal., the Railroad Commission of California has denied the application of the Pacific Gas & Electric Company for permission to install electric power in the Empire and North Star mines. In doing so the company would have discontinued the existing water-power supply at the mines and would thus, it was asserted, have deprived the farms of the irrigation service furnished by the distribution of this water after it had served its first purposes.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Hydro-Electric Development in Arkansas.—Final plans of the Arkansas Hydro-Electric Development Company, which contemplates the expenditure of $3,000,000 in White and Cleburne Counties, Ark., in the development of a hydro-electric plant on Little Red River, are for the erection of two power houses and 130 miles of transmission line. One power house will have an installation rated at 10,500 kw. and the other power house one rated at 6,000 kw. The project calls for the development of 22,000 hp. and the construction of two dams 500 ft. and 550 ft. in height.

South Dakota's Water-Power Resources.—Finding fault with an official map of water-power resources reproduced in the New York *Times*, which gives to South Dakota only one-tenth of 1 per cent of the nation's total, Doane Robinson of Pierre, S. D., writes to that newspaper: "Briefly, South Dakota is among the big commonwealths in potential water power, and we are well on our way in the preliminaries which will develop 500,000 commercial horsepower, or about 1 per cent of the total available in the United States, a development which will save the consumption of 2,000,000 tons of coal annually."

Union Opposition to Electricity in Mines.—According to a dispatch to the Philadelphia *Record*, Thomas Kennedy, president of District No. 7, United Mine Workers, has asserted that he contemplates further activities for inducing the next Pennsylvania Legislature to consider prohibition of the use of electricity in mines, as proposed a few years ago when a mine law code was under debate. Mr. Kennedy cited as an instance of the alleged danger in the use of electricity a fire at the Harwood plant which furnishes power to a score of towns and collieries. The service was suspended from 1 to 11 p.m., and Kennedy declared such an occurrence might at any time cause hundreds of fatalities through failure of ventilating systems driven by electricity to work.

The Minneapolis Dam.—As a result of passage by Congress of the water-power bill, St. Paul, Minneapolis and the University of Minnesota, as members of the Municipal Hydro-Electric Corporation, are, says the *Improvement Bulletin* of Minneapolis, in a position to acquire the power created at the high dam in that city. Under the bill, if the government does not erect the high dam plant, the rights may be obtained through lease by the municipal corporation or by private corporations. The municipal corporation has authority to finance the project through legislative enactment. Engineers who made the investigation for the War Industries Board estimated that the plant would cost between $1,250,000 and $1,500,000. It is believed that under present conditions the plant would cost at least $2,000,000. The report also showed that the maximum power to be developed to high-water stages was 12,000 kw. and the minimum 3,000 kw. George R. Smith, former congressman, who led the fight for the measure in Congress in 1916, said: "Expenditure of the money necessary to build and equip the power plant and provide distribution of the electricity, even in these abnormal times, would be warranted, although it might be advisable to wait a short time. The foundation the government built is worth half a million dollars today. To erect a superstructure and equip it with machinery would not cost more than $500,000. But the distribution would be the greater element of expense."

An English Farm Wind Turbine.—Electric plants driven by wind power are to be found in various countries of northern Europe. The *Electrical Times* of London contains an account of a motor being erected on an English farm to replace an oil-driven set. When completed it will drive a dynamo, pump water and do other farm work. Wind turbines like the one in question are from 6 ft. to 20 ft. in diameter, with single or multiple motors, and their power may be increased by adding more vanes. The tower is of steel, fitted with ladder and platform and with veering arrangements to keep the face of the motor square to the wind and automatic gear to cut off wind above the desired velocity. For use with a dynamo batteries are necessary for storage of the energy. The initial outlay at present high prices is about £100 for a turbine developing 1 hp. in a 15-mile-per-hour wind. Fuel costs nothing and upkeep little.

More Rate Increases Granted in Various Sections.—The Board of Electric Light Commissioners of Meriden, Conn., has approved an advance in the rates of the Meriden Electric Light Company of approximately 20 per cent for a three-month period which began July 1. The Public Service Commission of West Virginia has increased the rates of the Hartland Power Company of Clay County, now in the hands of a receiver, by permitting a surcharge of 125 per cent on monthly bills for power used based upon a primary charge and 150 per cent on bills for power based upon a secondary charge. The city of Fort Wayne, Ind., and the Indiana Service Corporation have, with the approval of the Indiana commission, agreed upon a fuel clause providing that for each 5-cent increase in the average monthly cost of coal above $3.60 per ton delivered at the power houses there be added to the monthly bill 0.15 mill per kilowatt-hour, with a corresponding decrease in case the cost of coal is less than $3.40 a ton.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Apportionment of Taxes of Utility Operating Two Departments.—In the case of a utility operating both an electric and a water department, the taxes should, a decision of the West Virginia Public Service Commission affirmed, be borne by each department in proportion to its respective value.

Disconnection Charge Authorized.—Complaint being made concerning a charge of $1 made upon the disconnection of gas or electric service by the People's Power Company in cases where the consumer had used the service less than one year at that location, the Illinois Public Utilities Commission found the charge to be justified by the expense involved, although, owing apparently to an oversight, it had never been included with the scheduled charges on file with the commission.

Neglect to Add Surcharge Does Not Prevent Collection Later.—The Railroad Commission of California in a recent decision held that the fact that the Coast Valleys Gas & Electric Company, through an oversight, neglected to add the surcharge allowed by the Railroad Commission on bills for power furnished a mining company constituted no reason why the mining company should not pay the surcharge when the bill was presented. The commission dismissed the complaint brought against the power company by the mining company because of the power company's effort to collect the surcharge in a lump sum.

Powers of Indiana Commission.—Inasmuch as the Indiana statute contains no emergency clause authorizing regulation of service, the Public Service Commission disclaims power to relieve a utility from the standards of service set up in an unsurrendered franchise. However, notwithstanding the maximum rates provided in franchises, the commission has the power temporarily to increase such rates to meet emergency situations and may also increase minimum rates or establish a minimum charge if none exists. The commission, in its own opinion, does not have the jurisdiction to require a utility to make extensions within a municipality.

Protection from Competition.—On complaint of a customer of the Bucks County Electric Company whose service had been discontinued because he violated a rule of the company forbidding him to use any other electrical energy than that furnished by the company without first obtaining its consent, the Pennsylvania Public Service Commission has ordered the rule in question rescinded, holding it to be "unjust and unreasonable." "The utility may," the commission said, "adopt rates which will secure it an adequate and reasonable return for the service which a particular class of customers demands, but it cannot refuse its service simply because the customer does not purchase all of his electricity from it."

What Constitutes an Electric Utility.—In dismissing the complaint of the Union Electric Light & Power Company against the Tibre Power Company, the Public Service Commission of Missouri has found that an industrial plant selling surplus electrical energy upon its own premises to a few consumers within a limited area is not a public utility subject to the jurisdiction of the commission. The crossing of a public street with the transmission line is not the controlling factor.

Missouri Commission Grants Variable Rates Based on Costs of Coal and Labor.—Permission has been granted by the Missouri Public Service Commission to the Cupples Station Light, Heat & Power Company of St. Louis to increase its rates for all classes of service by means of fuel and labor clauses operating as a sliding scale. These clauses took effect on July 3. By their provisions, which are similar to those of an order obtained by the Union Electric Light & Power Company a year ago, 0.045 per cent per kilowatt-hour shall be added or subtracted for each increase or decrease of 1 cent or major fraction thereof above or below the cost of 14.5 cents per 1,000,000 B.t.u. for coal delivered in the company's bunkers, and 0.012 cent per kilowatt-hour shall be added or subtracted for each increase or decrease of 1 cent or major fraction thereof above or below an equivalent hourly wage of all employees (excluding department heads and officers) of 58 cents an hour.

Contract Limitation of Service to Installations of 75 Kw. Unconstitutional.—A contract entered into between the Niagara & Erie Power Company and the town of Dunkirk for the extension of electric service now furnished to the municipal plant of the city of Dunkirk into the surrounding town has been declared unconstitutional by the Public Service Commission for the Second District of the State of New York, as contravening the transportation corporations law of the state, which forbids discrimination between customers. The discriminatory clauses of the franchise which the commission disapproves are one forbidding the company to furnish electrical energy to consumers whose requirements for power are less than 75 kw. and one specifying that the company shall not be compelled to supply consumers of 75 kw. or more unless "a reasonable return upon the necessary investment" shall be received. Under the contract the company could not sell its product for redistribution to any except the city of Dunkirk, its other customers to be such as the city was unable or unwilling to supply and business with them to be limited by the provisions just stated.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Eminent Domain and Electric Utilities.—The Commission of Appeals of Texas has declared that the laws of that state in providing for condemnation of land by gas and electric companies do not extend to such companies the provision by which railroads, pipe lines and telegraph and telephone lines are enabled, in case of a suit against them by a landowner, to litigate the question of condemnation, the provision alluded to being a special one and not included in the law that governs gas and electric companies. (222 S. W. 217.)

Declaration of Death of Child from Uninsulated Wires Furnishes Legal Cause of Action.—In Love vs. Virginian Power Company, where damages were sought because of the death of a child from electric shock received while playing on a pile of slag placed under defendant's high-tension cables subsequent to their erection, the Supreme Court of Appeals of West Virginia held that sufficient cause of action had been stated in the complaint. The slag had been under the wires for two years, and the court held that the defendant knew or should have known that children were accustomed to play on it. When a company maintains a high-tension line in a place where others may lawfully resort from motives of business, pleasure or curiosity it is bound to take precaution for their safety by insulating the wire or other adequate means. (103 S. E. 352.)

Public Service Commissions and the Fourteenth Amendment.—Affirming that an order of a state public service commission prescribing a schedule or maximum future rates is legislative in character, the United States Supreme Court has declared that the Pennsylvania public service company law—construed by the state Supreme Court as withholding from the courts power to determine the question of confiscation according to their own independent judgment, on an appeal from an order of the commission fixing rates—denies due process of law under the Fourteenth Amendment unless it clearly authorizes some other proceeding in which the order may be challenged as confiscatory; nor does the section of the public service company law relative to injunctions provide such a proceeding. A decree of the Supreme Court of Pennsylvania sustaining an order of the commission has been reversed by the United States Supreme Court for the foregoing reason, and the case—one involving the rates of a water company—remanded. (40 S. C. R. 527.)

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Col. Dudley J. Hard, the newly elected president of the Ohio Electric Light Association, is both a native Ohio central-station man and a soldier. He was born and educated in Wooster, Ohio, where for the last eleven years he has been vice-president of the Wooster Electric Company, which was organized by his father, C. V. Hard, in 1886, when there were only two other electric lighting companies in the state. Colonel Hard has been in the central-station business since his graduation from the University of Wooster in 1893. In 1894 he was elected secretary and treasurer of the Cleveland Light & Power Company, and he still holds that

DUDLEY J. HARD

dual position in addition to his official connection with the Wooster company. When a boy the future central-station executive was much interested in military matters and for about thirty years dating from 1888 he was a member of the Ohio National Guard. During that time he served his country in a military capacity on three occasions, first at Santiago in the Spanish-American War as a lieutenant of the Eighth Ohio Infantry, then on the Mexican border in 1916-17, where he commanded the Ohio cavalry as major of the First Ohio Squadron, and lastly as colonel of the 135th Field Artillery, with which he spent nine months in France. The honor which the Ohio central-station men have bestowed upon Colonel Hard was also conferred upon his father some years ago.

O. M. Booher, who for the past twelve years has been manager of sales for the Indiana Railways & Light Company, Kokomo, Ind., has resigned to become general manager of the Kokomo Brick Company. Mr. Booher was very active in committee work of the Indiana Electric Light Association.

Edward W. Harry has resigned as electrical engineer for the National Tube Company, to become chief electrical engineer with the Pittsburgh Steel Company at Monessen, Pa. Mr. Harry started with the electrical department in 1910 as a lineman and while in this employ took a course in electrical engineering at Carnegie Institute of Technology, being graduated in 1915. While employed in the department he had a varied experience as lineman, armature winder, meterman, draftsman, electrical designer and engineer.

T. D. Ramm has resigned from the St. Paul Gas Light Company, where he was general superintendent of the electrical division, to become connected with the Pennsylvania-Ohio Electric Company, Youngstown, Ohio. Mr. Ramm started with the St. Paul company as a cadet engineer seven years ago and was successively promoted to assistant electrical engineer, electrical engineer, assistant superintendent, superintendent of distribution, assistant to the engineer and general superintendent.

Lloyd Henley, electrical engineer with the California Railroad Commission, has left the commission to take up the work of rate research engineer with the San Joaquin Light & Power Corporation. Mr. Henley was graduated from Stanford University with the class of 1908 and entered the construction department of the Pacific Gas & Electric Company. For a time he was with J. G. White & Company in the construction of the Bakersfield steam plant for the San Joaquin Light & Power Company. He rejoined the Pacific Gas & Electric Company when that company

LLOYD HENLEY

started the Drum-Spaulding project. For a number of years Mr. Henley was foreman of the Drum power house leaving that company to accept a position with the California Railroad Commission in 1918. A short time ago Mr. Henley was made chairman of the committee that is revising the rules for overhead line construction for the State of California.

Obituary

James Mitchell, president of the Alabama Power Company, and one of the pioneers in the electric railway field, died at his home at St. James, Long Island, N. Y., July 22, aged fifty-four. A Canadian by birth, he was educated

JAMES MITCHELL

at the Milton (Mass.) High School and in 1884 joined the Thomson-Houston forces at Lynn, Mass. Here he was kept busy making the apparatus used by Professors Thomson and Rice until advancement came and he had charge of the manufacturing company's first stationary and railway motors. He then entered the railway department and was instrumental in installing electric steel railway systems in a number of cities, besides placing in Brazil the first electric street railway in South America. For seventeen years he was in South America installing street railway and electric systems. After his return to the United States he devoted his attention to the Alabama Power Company. This company under Mr. Mitchell's direction has had a most remarkable growth, having now considerably over 100,000 hp. installed in its various plants. He was one of the early advocates of electric steel production and at Anniston, Ala., he laid the groundwork for a rapidly growing electric steel and ferromanganese industry.

Adrian Onderdonk Schoonmaker, president and treasurer of the A. O. Schoonmaker Company, mica manufacturers, died in New York on June 23. Mr. Schoonmaker was born Aug. 4, 1851, and was graduated from the Brooklyn Polytechnic Institute. He entered the mica insulation business when a young man and at the time of his death had built up a very considerable business.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Greater Use of Trade Acceptance Strongly Urged

THAT the trade acceptance is coming more and more into use by electrical supply jobbers is fully attested by reports from several sources. Representative jobbers throughout the country are using it as a means of stabilizing not only their own credit standing but also that of their customers, and they are pushing it wherever they see that benefit will result. One of the more significant results is that of converting open accounts, which have acquired a habit of running sixty or seventy-five days or so, to a trade acceptance basis for payment in forty-five days, at the same time permitting discount at the bank.

It is perfectly true that this method of collection has not been sold to all jobbers, and it is very probable that by the old method of open account the jobber is able to keep some business which otherwise he would lose. But there is room to question the value of such accounts. There is no doubt that many jobbers not now using acceptances would take them up if they were thoroughly acquainted with their use.

The National Association of Credit Men only two months ago in convention strongly expressed its approval of the trade acceptance as a desirable credit instrument, thus reaffirming its position on this question as taken in previous years. The banking and currency committee of this association particularly stresses the value of the trade acceptance in the conversion of indifferent and slow debtors to prompt payers and frequently to discounters. That committee believes that as a collection instrument nothing better was ever devised, but believes its purpose is defeated if taken in payment of past-due accounts.

The electrical industry has not come to the front in any particular in the use of this form of credit, but it is learning the game. Certain houses in other lines of business are teaching their salesmen the value of this instrument and these salesmen are consequently much better fitted to assist in converting slow payments into good collections for their own house.

Discounting of trade acceptances is generally confined to the banks in the communities where the paper originates and enjoys a rather limited market. According to one Federal Reserve bank, of nearly $11,000,000 of trade acceptances handled for collection during the period of Jan. 1 to May 31, 1920, $9,500,000 were paid at par, and exchange charges on the remainder amounted to about one-tenth of 1 per cent.

Strong Market Ruling for High-Tension Insulators

ALTHOUGH the production of high-tension insulators is said to be up to normal capacity or nearly so, demand has increased to such an extent that it now far outstrips available supply. Not only is a good volume of domestic orders reported, but the call coming from foreign countries since the war has been steadily increasing and export orders are now an important factor in the business. South American countries, France, Italy and the Scandinavian peninsula offer especially favorable markets for porcelain insulators, and replacements seem to be about an equal factor with new construction work in accounting for the demand.

Manufacturers when questioned regarding stocks of finished goods throw up their hands in despair at the very suggestion of the existence of such a thing. Reports on the raw-material situation, however, are not so uniformly bad, for although this item is undoubtedly causing delay, the use of personal tracers to locate shipments and careful attention to ordering supplies long ahead have guarded against an acute shortage. Little labor trouble has been experienced in this field, although in one or two quarters some shortage of skilled workmen is reported.

With the output of insulators unable to keep pace with demand, delivery dates have been growing longer. Six months is about the very best figure quoted, and delivery dates run all the way up to ten months, depending upon the size and type. Medium-voltage sizes around 35,000 to 45,000 volts seem to be in the best shape as regards deliveries, while the highest voltage types are the worst off in that respect. Suspension insulators in several cases are reported a little easier than the pin type, and although in the former case the metal parts are a factor in production, the metal is not holding up the program so much as porcelain. In spite of long deliveries, an almost entire absence of cancellations is noted.

Prices at present are high, and opinions differ as to whether further increases may be expected. No price change is reported since the advances made a month and a half or more ago. Manufacturers in this line as a whole report their bills are being met fairly promptly and that little trouble is experienced with collections.

Foreign competition seems still to be a negligible quantity in affecting the American market for high-voltage insulators, as the industry abroad has not as yet sufficiently recovered from its period of war apathy.

Transformer Market Continues Active

TRANSFORMER manufacturing plants are busy filling back orders and taking on new business, although some diminution is noted in the volume of inquiries and extent of so-called proposition work, compared with earlier in the year. Not much difference can be seen in the character of buying, both power and distribution transformers being sought in about the usual proportions. The passage of the national water-power act has opened the door to larger sales, sure to be realized more and more as these resources are developed. As yet it is too early for this legislation to exert a substantial effect on orders, but considerable business is looked for from Western sources as projects long imprisoned on paper are released for construction.

An improved material situation as regards the heavier items used in transformer manufacture features present conditions. Manufacturers are less worried today over the supply of copper, magnetic steel and sheet iron than during the past winter. Railroad congestion has given cause for anxiety all through the year, but by strenuous efforts necessary stocks of the foregoing raw material have been accumulated in sufficient amount to permit steady production to be assured for some time. The chief difficulty has come in connection with the supply of such items as long-fiber cotton, shellac, enameled wire for primary coils, porcelain and grain alcohol.

For about six weeks a strike in the Naugatuck Valley of Connecticut interfered with copper deliveries to manufacturers of transformers and much other electrical equipment, but with the failure of this walkout conditions have greatly improved. Difficulties still exist in connection with the cotton supply, these being heightened by the large pur-

chases of this material by the automobile industry. It has become necessary, in some cases at least, to buy shellac abroad before shipment to the United States, in order to forestall complete absorption of imports on arrival. Facilities for local manufacture of enameled wire and porcelain will soon be established in at least one representative transformer-making plant, so that these materials will cause less trouble in future from the shortage standpoint.

Deliveries of distribution transformers now average about eighteen weeks, although occasionally much shorter shipments can be made. On power transformers, classed at 200 kva. and over, shipment can be made in from five to eight months. There are practically no factory stocks in hand of either type. Labor conditions are fairly steady, and prices have been quiet but firm since the last advances, which took place in the late winter and spring. Every effort is being made through quantity production and by pushing the standardization program to hold prices close to present levels, which are still far below the advances attained in many other lines of commodities. If pig-iron advances further this summer, it seems likely that transformer prices may have to undergo another upward readjustment, but there is little certainty at present about this. A bright spot in this branch of the industry is found in the results of rating standardization, which have cut the sale of specials to one-third that of four years ago and reduced the number of standards to about 40 per cent of the old figures.

Graphic-Recording-Meter Market Growing Fast

MANUFACTURERS of graphic recording meters uniformly agree that demand today is probably greater than ever before in that line, and not only have sales for the first half of this year greatly exceeded those of last season but inquiries seem to be steadily increasing. The remarkable favor in which this instrument stands can be traced to the growing tendency of power consumers to check up their costs. According to one of the big producers of recording instruments, hardly a single electric power installation is now made without including a graphic recording meter in the equipment. Reports are about evenly divided as to whether the greatest part of this call comes from central stations or manufacturing plants, but these two classes of buyers between them undoubtedly account for a very large proportion of the orders.

A survey of the field reveals very short stocks in the hands of manufacturers, but this condition is not so alarming as at first appears, in view of the fact that most of these meters are made to order and light stocks are usually the rule. But even so, the available supplies are rather sub-normal and the main factor promoting this condition would seem to be the rapid increase of demand, which has outstripped facilities for adequate production, even though that production at present seems to be proceeding at normal capacity, as judged by the standards of the past. Another consideration, of course, has been the freight muddle, and to some extent supplies of raw material, although this item was in several cases reported to be in pretty fair shape.

Under these conditions, deliveries in this market are considered pretty fair, although some manufacturers were much worse off than others in that respect. From four to six weeks were the best dates quoted, and other estimates ranged as long as ten or even twelve weeks. One of the producers who was among those able to make the quickest deliveries, stated that his shipments were sent only by express. No present labor difficulties are reported, as this phase of manufacturing conditions has presented a favorable aspect since some trouble with labor was experienced in certain quarters last spring. An entire absence of order cancellations is also noted. Prices for graphic recording meters have remained stationary for about two months and in some cases an even longer time, but before that period increases strung along in amounts of from 5 to 10 per cent. Several representative makers think prices are likely to hold firm.

Analysis of Exports of Transformers for the Year 1919

THE value of transformers exported from the United States during 1919 ranked sixth as regards classes of electrical apparatus exported, last year's exports of this product amounting to $3,787,851. The highest monthly value was recorded in March, amounting to $449,077. The average monthly rate of exportation was $315,654. With the exception of August the monthly values of exports were below the average for the second half of the year.

Exports of transformers for the first five months of 1920 amount to $1,482,712, which is at a rate of more than

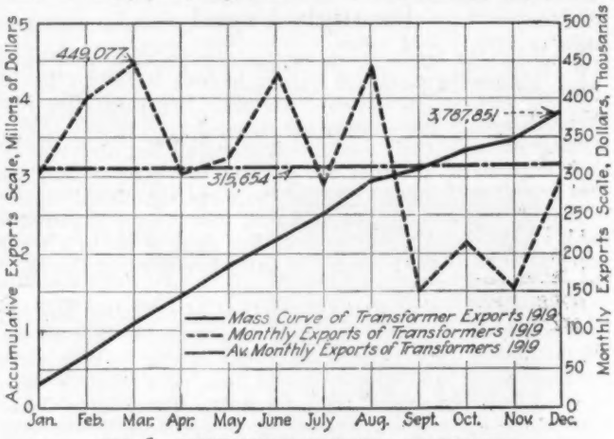

Accumulative Exports Scale, Millions of Dollars
Monthly Exports Scale, Dollars, Thousands
449,077
3,787,851
315,654
Mass Curve of Transformer Exports 1919
Monthly Exports of Transformers 1919
Av. Monthly Exports of Transformers 1919
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov Dec.

FIG. 1—MONTHLY VARIATIONS OF EXPORTS

$3,550,000 for the year. This is below the actual exports for last year, but, with the exception of the month of April, the monthly rate for this year has been holding up well.

Data compiled by the ELECTRICAL WORLD indicate that 14 per cent of this class of exports were consigned to Brazil, with a total of $538,325. Japan and Australia were second and third, with $366,167 and $272,581 respectively. Fig. 2 indicates the large extent of exports to various foreign countries. France, Italy, Norway, Portugal and Spain imported American transformers valued at $837,629, which is about 22 per cent of the total value of this class of exports to all countries. Fig. 2 also indicates the extensive market in South America for this class of electrical goods. Seven of the countries of that continent imported American transformers valued at $983,998, which is about 26 per cent of the total value of this class of exports to all countries. To

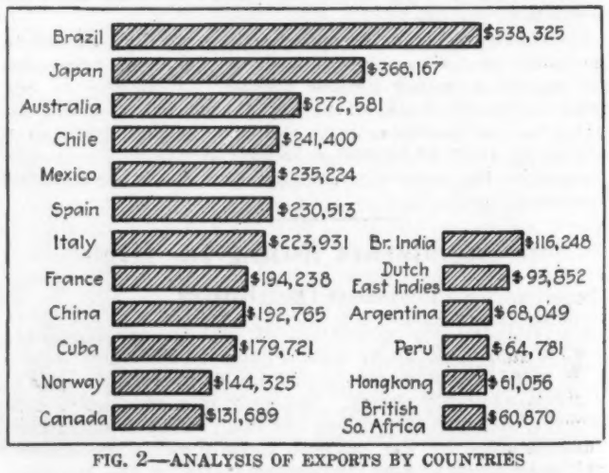


FIG. 2—ANALYSIS OF EXPORTS BY COUNTRIES

Canada, Mexico and Cuba exports of these goods totaled $546,634, about 15 per cent of the total of these exports. Taking into consideration, therefore, only such countries as imported $25,000 or more of this class of American electrical goods, continental American trade accounted for $1,530,632 worth, or about 41 per cent.

The above figures are based on export statistics issued by the Bureau of Domestic and Foreign Commerce for 1919.

Demand for Integral Horsepower Motors Easier

AT LEAST temporarily, the demand for integral horsepower motors appears to have slackened off a little, but the large volume of unfilled orders on factory books insures ample work in this field for many months to come. By and large, the motor business now being booked probably runs 25 per cent above that of a year ago. Prices have remained steady since March, but a further advance is not unlikely if transportation conditions grow worse, unless, of course, the volume of business should fall off materially. Representative deliveries on alternating-current motors are from three to six months, and on direct-current motors about fifteen weeks.

The quotations on single-phase motors show a little improvement in deliveries over last spring. New plants for the manufacture of both fractional and integral-horsepower motors are being established, and it is likely that considerable improvement in deliveries can be realized before the end of the year. Enameled wire is scarce, and while sheet steel can be obtained more readily than in the winter, raw-material conditions are none too satisfactory. Labor costs continue high, but some improvement in the temper of labor seems to be evident, shutdowns in other manufacturing fields exerting a constructive influence upon the workman's disposition to remain more continuously at his post.

Metal Market Situation

PREVAILING conditions in the copper market show the buying activity to be very light. Producers are booking orders here and there at 19 cents for prompt and third-quarter deliveries, while fourth-quarter deliveries are quoted at 19.25 cents. There is little activity in the longer deliveries, partly because it is not known definitely at this time what effect the recent increase in railroad wages will have on freight rates, other than that they will undoubtedly be advanced. It has been estimated, however, that rates will advance sufficiently to add about 1 cent to finished copper in its movement through production.

The outside market is quiet, with some sales reported made at interior points at 18.50 cents f.o.b. shipping point for prompt. But 18.62½ to 18.75 cents is nearer the outside market price. There is no evidence that producers are even considering weakening their position through any recessions in price. They feel a good buying movement in the near future and know their ability to hold on.

On July 21 the official lead price was advanced ½ cent, to 8.50 cents. The outside market, however, is quoting prompt lead from the West up to 9.25 cents New York. Mine output is below normal because of labor shortages, and the spot market is extremely low. At the same time future activity is negligible in the outside market. Scrap lead shows a quarter-cent advance.

Zinc consumers show little interest and several outside lots are finding no buyers.

NEW YORK METAL MARKET PRICES

	July 20	July 27
Copper	£ s d	£ s d
London, standard spot	91 5 0	92 0 0
	Cents per Pound	Cents per Pound
Prime Lake	19.00	18.62½
Electrolytic	19.00	19.00
Casting	18.25	18.00
Wire base	22.50–23.00	22.50–23.00
Lead, trust price	8.00	8.50
Antimony	7.50	7.25
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	12.50	12.50
Zinc, spot	8.25	8.10
Tin	49.75	48.75
Aluminum, 98 to 99 per cent	33.00	33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	15.50 to 16.00	15.50 to 16.00
Brass, heavy	9.50 to 9.75	9.25 to 9.50
Brass, light	7.25 to 7.75	7.25 to 7.75
Lead, heavy	7.00 to 7.37½	7.25 to 7.50
Zinc, old scrap	5.00 to 5.50	5.00 to 5.50

THE WEEK
IN TRADE

IN THE Middle West and on the Pacific Coast trade dullness and general summer apathy are slowing up sales of electrical material, while in the East business is also slacking, but a good volume of sales is still reported. In the South the brisk demand for all electrical material continues, with no let-up as a result of the heavy building construction program.

An improved freight situation is everywhere reported except in Atlanta territory, where car shortage is seriously holding up the supply of building material. Reported heavy demand on cars for the movement of wheat is also a factor which has now to be reckoned with. Under the influence of lessened sales and better shipments, stocks seem to be uniformly picking up.

Labor conditions appear pretty steady, although certain electrical workers on the West Coast are demanding higher wages. Collections in general seem to be tightening over the country, but although caution is used with regard to credit, an optimistic feeling prevails as to the future.

A good volume of construction work is under way in the East and at points South, while a large amount of this work is also contemplated for the near future in the Middle West, which has so long been delinquent in that respect. Residence construction in the Northwest district has slackened, seemingly because builders are expecting lower prices to prevail on lumber.

NEW YORK

Jobbers continue to report a quieter market than for some weeks past, with a slight slackening up of sales for all classes of electrical material.

Reports on the transportation situation seem to be about evenly divided as to whether freight deliveries are easing up to an appreciable extent. In several quarters, however, shipments are said to be coming through in much better shape than heretofore.

There are signs of approaching relief in the chaotic condition prevailing in the building material supply situation, according to the Dow reports, and when this relief materializes a greater volume of residence construction may be expected on the part of those who have been postponing building operations awaiting the advent of more favorable conditions.

Collections in the metropolitan district seem to be tightening up, with credit cautiously extended. Prices show no change since the recent withdrawal of quotations on porcelain items and schedule material. Pipe is in as bad shape as ever, but an easing up in the supply of flexible armored conductor seems to be evident. Little real fan weather has been felt as yet, and light sales are responsible for overstocks.

Tape.—Fair stocks of the friction type seem the rule, although here and there some shortage is reported. Good demand is felt at prices of from 52 cents to 60 cents per pound. Rubber tape seems to be in less call, with fairly good stocks and prices ranging all the way from 47 cents to 60 cents a pound, depending upon the quantity.

Rigid Conduit.—No relief in the situation is reported. Irregular receipts of car lots melt at once in the face of an unslackening demand. Poor stocks are on hand, with ½-in. black ranging in price from $92 to $96 per 1,000 ft., and the 1-in. size from about $180 to $200.

Flexible Armored Conductor.—A falling off in demand and improved shipments have eased up the situation, with signs of stocks beginning to show. Quotations in 1,000-ft. quantities are ranging around $115, though in one case price was under $100.

Fans.—Some jobbers find themselves overstocked, and others have canceled outstanding orders for the remainder of the season. With the unseasonable weather prevailing stocks have moved very slowly.

Rubber-Covered Wire.—This is in good demand, with plentiful supplies on hand and fairly regular shipments arriving. No. 14 is quoted at from $11.25 to $11.50 per 1,000 ft.

Vacuum Cleaners.—Embargoes are holding up stocks, and those jobbers who go in for this specialty claim they can't obtain enough to meet the present strong demand. One distributer has run out of attachments.

Switches.—Stocks of the snap and push-button types are in good shape with a normal demand prevailing. A good supply of knife switches is also available to meet the fairly steady demand which is felt. Shipments of toggle switches in one case are quoted at from five to six months.

Lamps.—Stocks, which a few weeks ago were decidedly spotty, are now generally well filled up, awaiting an expected heavy fall trade. An average summer demand is experienced.

Flashlight Batteries and Lamps.—No trouble is reported in meeting the usual vacation season demand. Stocks are in fair shape with pretty regular shipments.

Conduit Fittings.—Jobbers seem to have fairly good stocks of fittings, with some few short items owing to raw-material difficulties. Demand is uniformly good, but reports on shipments vary.

Fuses.—Plentiful stocks and a demand which in most cases is said to be normal are evidenced in this line. The call seems to be about evenly divided between the renewable and non-renewable types, with good shipments the rule.

BOSTON

Midsummer dullness in trade was in evidence at the close of last week. While a healthy volume of business is being transacted, the pressure upon jobbing houses has relaxed sufficiently to permit the building up of local stocks beyond recent unsatisfactory levels, except in motors, weatherproof wire and the lighter appliances for table use. Collections show little change over last week. Prices hold firm and deliveries are gradually improving. Building and engineering contracts in New England for the week ended July 22 totaled $5,513,000, compared with $5,135,000 in the same week last year. The total of contracts in 1920 to July 22 is $199,196,000, against $100,874,000 for the same period in 1919. In other words, new building is at present increasing about 7 per cent over last year. Contractors in the electrical field are very busy on numerous "piecemeal" jobs, especially in the industrial field. Labor conditions in the electrical industry are fairly steady in this section for the time being.

Motors.—Famine conditions prevail in the small-motors market. Prices are firm, with a slight recession in demand.

Wire.—Weatherproof wire is reported extremely scarce this week, quoting on a 29-cent base. Rubber-covered wire is in good supply, No. 14 bringing $11 per 1,000 ft. in 5,000-ft. lots. Bare copper wire, on a 24-cent base, is in fair supply.

Non-Metallic Flexible Conduit.—Sales are holding up well, with more satisfactory deliveries than formerly. Prices are steady, the ⅜-in. size quoting $33.50 per 1,000 ft. in 5,000-ft. lots, and the ½-in., $38.50 in 1,000-ft. lots.

Sockets.—No scarcity is reported this week. Pulls in case lots bring 50 cents each, net; keys, 28 cents, and keyless, 26 cents. New England stocks have been well maintained since the railroad tie-ups of late winter, which resulted in concentrated shipments from local factories to local jobbing houses.

Knife Switches.—A brisk demand is reported, due to many non-spectacular but useful central-station line extensions. Outdoor substation construction is active, calling for much fitting material.

Rigid Conduit.—Stocks are not very satisfactory. In lots of under 2,500 lb. galvanized pipe brings $11.10 per 100 ft. for ½-in., $22.20 for 1-in., $36 for 1½-in., and $48.60 on 2-in. sizes.

Flashlight Batteries.—A shortage in No. 790 dry cells has been remedied. In lots of twelve these bring 28 cents each.

Locust Pins.—These are quoted at $50 per 1,000 in lots of 500, with a fair supply.

Flexible Armored Conductor.—In 1,000-ft. lots this material brings $110 per 1,000 ft., in the No. 14 single-strip. No particular difficulty in obtaining supplies is reported.

Fans.—Stocks are not yet exhausted. The season is continuing relatively dull. In lots of twelve 25 per cent off list is quoted.

Toasters and Percolators.—The market is still very short of these devices.

CHICAGO

Unseasonable weather continues with temperature prevailing about 20 deg. below expectation. This, together with the usual vacation slump, has taken all the life out of the retail trade and is being reflected in a noticeable reduction in calls on jobbers for seasonable goods. Freight is moving more easily and in most lines stocks are getting in better shape than they have been for some months past. Construction remains quiet. Architects report an enormous amount of work "on the boards," but the greater portion of it is held up awaiting favorable conditions. Permits for the past two weeks aggregate nearly $4,000,000, of which more than half applies on buildings now nearing completion. Residence construction for the period named totals about $400,000.

Rigid Conduit.—More liberal quantities are being received by jobbers and back orders are being materially reduced. Light demand for new construction purposes is enabling stocks to build up to some slight extent. One-half-inch and three-quarter-inch sizes are most in demand and hence hardest to get.

Non-Metallic Flexible Conduit.—Popular sizes for immediate delivery are difficult to obtain, but jobbers are improving their stock conditions every day. Lightened demand by the construction industry accounts for this. Current quotations are $35 per 1,000 ft. for ⅜-in. in 5,000-ft. lots and $37 for ½-in.

Wire.—A reduction in the placing of new business and more favorable shipping conditions are combining to put stocks in better shape than they have been for a long time. A falling off is noted in calls for wire for maintenance work.

Flexible Armored Conductor.—One hundred and twenty dollars per 1,000 ft. is today's price on No. 14 single strip in short lengths, $110 in coil lengths. These prices show no recent change. Stocks are in fair shape, most sizes being readily obtainable.

Underground Cable.—Former great difficulty experienced in getting goods through from Eastern factories is considerably lessened, and as a result deliveries are becoming more prompt. New demand is off, but jobbers are still busy filling back orders.

Electric Signs.—Relief in freight conditions as regards receipt of raw materials has lessened the problems of the manufacturer, and on ordinary stuff delivery can be made fairly prompt. New business shows a decrease compared with that placed during the spring.

Electrical Toys.—In expectation of heavy demand for Christmas trade jobbers are asking dealers to list their requirements now. Uncertainty as to the volume of business this winter is rendering retailers a little cautious. Jobbers seem in pretty good shape as to supply.

Vacuum Cleaners.—Retail sales are holding up very well, and deliveries for the most part are made from stock. Little deferred payment business is done, cash transactions being in the majority.

Heaters.—Most dealers are anticipating heavy business this fall, owing to the high price of coal, and as a result they are ordering heavily.

ATLANTA

Building permit figures for the twelve principal Southern cities for the month of June, 1920, show an increase in construction value of 25 per cent over the same month of last year, while a tentative report shows an even greater percentage increase in the smaller centers. It is this construction that in large measure accounts for the continued brisk demand for all classes of electrical material. Building permits for Atlanta for the first half of July total $537,000.

Bank clearings have settled to a figure only slightly in excess of a year ago, and all lines of trade are reporting a tightening up in the money market, every effort being made to collect outstanding accounts. Collections are coming in rather slowly from the smaller operators, as well as from small municipalities and central stations, but the large jobbers continue to meet their obligations promptly.

Flexible Armored Conductor.—A price increase of approximately 5 per cent is announced. The demand continues very brisk with few or no satisfactory stocks in the territory. Price, lots of 1,000 ft. to 2,500 ft., $12.20 per 100 ft.

Porcelain.—The situation continues unsatisfactory, though a large shipment of knobs, cleats and tubes and so forth is expected daily. This shipment will serve to fill a large portion of outstanding back orders. A price advance of approximately 10 per cent is to be noted on all items. Quotations are as follows: "Nail-it" knobs, lots of 500 to 4,000, $5.45 per 100; two-wire unglazed cleats, lots of 300 to 1,850, $3.50 per 100; ⅛-in. x 4-in. tubes, standard packages, $1.72.

Rigid Conduit.—The shipment of conduit recently reported was quickly absorbed and the market is again short on this item. Demand continues very brisk with prices steady. The car shortage seems to be causing the principal difficulty in the receipt of shipments.

Flexible Non-Metallic Conduit.—Recent shipments have served largely to clean up all back orders, though no stocks are at present in the territory. Shipments now rolling, however, will permit of a fair accumulation in local warehouses. Prices, 1,000 ft. to 2,500 ft., ⅛-in., $4.62 per 100 ft.; 3/32-in., $4.24 per 100 ft.

Wood Poles.—The car shortage is preventing delivery of badly needed supplies, producers reporting adequate stocks on hand which they are unable to move. The demand is insistent, particularly from small distributing systems which have undertaken to rebuild lines that have been allowed to get in bad condition. Prices, f.o.b. Atlanta, Western red cedar, 30-ft., $12; 35-ft., $14.50.

Cross-Arms.—Good supplies of fir arms in both standard and N. E. L. A. sizes are to be had from jobbers' stocks, and pins and glass insulators are also on hand in good quantities. The demand is brisk and stocks are moving rapidly despite the difficulty in obtaining poles. Prices, N. E. L. A. arms, four-pin, 5-ft., $1.68; standard arms, four-pin, 4-ft., 99 cents; two-pin, 3-ft., 74 cents.

Schedule Material.—With the exception of rosettes, fairly satisfactory stocks are reported, there being a plentiful supply of both key and pull-chain sockets. The demand is holding up very well. Prices, key sockets, standard packages, 39 cents; pull-chain sockets, 58 cents; rosettes, combination one-piece, 10 cents.

SEATTLE—PORTLAND

Vacation season trade slackness, uncertain conditions and a general feeling of apathy characterize the situation in the electrical industry as far as the Puget Sound district is concerned. Sales volumes are still at a low ebb—perhaps a trifle lighter than for the past two weeks from the jobbers' standpoint. Retail sales of small appliances, however, are being well sustained. Contractor-dealers report further slowing up due to decreasing residence construction. The recent drop in lumber prices noted in Puget Sound cities has not stimulated building. Apparently prospective home builders assume that this drop indicates further decreases. However, lumbermen say this assumption is incorrect as relief from the car shortage will result in steadying the lumber market. Jobbers' stocks are improving gradually, owing to better shipments and lighter demand, though there is a shortage along some lines still.

Reports from the Spokane field state that wholesale business is fair and that a good number of sales recently has stimulated retail trade. Small motors, domestic appliances and fixtures are moving exceptionally well. House-wiring devices and schedule materials are also showing a fair movement. Collections are still good, but in the past two weeks they have been slowing up considerably.

Manufacturers and jobbers in Portland territory report that business is gradually picking up. Supplies are being received in greater quantity owing both to the fact that manufacturers are catching up somewhat with their orders and to improved railroad transportation. Oregon contractors, especially those in Portland, report that business is good considering the time of year. Prospects for future business at this time are looking fine. Retail trade is improving materially from week to week. Jobbers report that collections are improving somewhat, but contractors and retailers find them still very poor.

Washing Machines.—Seattle jobbers, generally speaking, report that demand for washing machines is not only holding up, but is even showing a noticeable increase. Shipments are coming through comparatively well but demand is in excess of available supply.

Motors.—Although the demand for fractional sizes is dropping off a trifle, it is still impossible to obtain anything like an early delivery.

Sockets.—Recent improvement in stocks is noted. With residence construction decreasing gradually, sales are dropping off.

Safety Switches.—Poor demand in Puget Sound territory has enabled fair stocks to accumulate. Shipments are improving and prices show no recent change.

SAN FRANCISCO

A very conservative policy adopted by the banks has created certain rumors of forthcoming financial changes, but as a matter of fact, this policy is far-sighted and will lessen the effect of any financial uncertainty. Particular attention is being paid by dealers to such financing assistance as the Morris plan, and it looks as if they have decided that it is important for them to give easy terms in competition with department stores.

The threatened power shortage has become acute in the Willows district of the Sacramento Valley. Furthermore, it is stated that some water from Lake Spaulding is being diverted through creek beds to the orchards on the slopes of the Sierras.

Heating Appliances.—The market for irons is slow on account of new prices, although there is no sign of any drop. On the other hand, the new prices of hollow ware have not affected the call, which is very heavy and which has left stocks bare. Holiday supplies will not arrive until October.

Ranges.—Power company officials state that they are amazed at the strong call for electric ranges despite the recent increase in price and the fact that no regular campaigning is being done. These orders are coming in through widely scattered dealers. Stocks, with the exception of automatic ranges, are rather poor, especially in the larger cabinet styles.

Motors.—The motor situation is growing worse, and delivery dates are being extended until they cover the greater part of a year. With another dry year the situation will become very serious.

Washing Machines.—Right through the summer season heavy sales continue with good stocks now to back them up.

Telephone Material.—Because of raw-material difficulties and the flooding of factories by orders, deliveries are very poor, not only of the sets themselves, but of such primary equipment as cable switchboards.

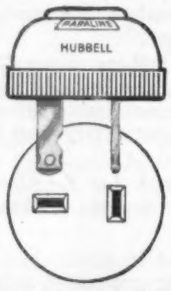
Tools.—Coast stocks of small linemen's tools are still shot to pieces because of the inability of factories to procure fine tool steel. Heavy construction tools are better off.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Attachment Plug with Rotatable Blades

By turning the blades the new attachment plug manufactured jointly by Harvey Hubbell, Inc., and the Benjamin Electric Manufacturing Company



SLOT COMBINATIONS FORMED BY TURNING BLADES 90 DEG.

may be adapted to fit slot receptacles whose slots are parallel, in line or at right angles to each other, the manufacturers say. The blades of the cap can be turned through 90 deg. to fit these combinations of slots. The product of the Hubbell company will be marketed under the registered trademark of "Paraline."

Industrial Lighting Unit

A new lighting unit designed both to distribute light over a wide area without glare and to concentrate it for close work on benches, machines, etc., in manufacturing establishments has been developed by the Perfection Sales Company, 329 East Twenty-second Street,

GLARE IS ELIMINATED

New York City. The unit consists of two shades, an upper opaque one and a lower translucent shade. The lower shade sends the light directly downward to the work. The upper shade deflects the light not only in a downward direction but also horizontally.

Anti-Rust Compound

For protecting steel and iron parts from rust during transportation, storage, etc., the Conversion Products Corporation, 149 Broadway, New York City, has developed a compound called "Stazon." It has a petroleum base and, according to tests, will not flow under temperatures around 200 deg. Fahr. Insulating properties are similar to petroleum greases and the compound acts also as a lubricant. It is especially adaptable to protecting bearings of armatures, shafting and bright steel parts from atmospheric conditions.

Heavy-Duty Buzzers

For use where a signal with a distinct but not necessarily loud tone is needed the Benjamin Electric Manu-

INDUSTRIAL SIGNALS FOR HEAVY DUTY

facturing Company, Chicago, has developed two types of heavy-duty buzzers, for both direct and alternating currents. Sturdiness of construction especially is claimed.

Notes on Recent Appliances

Time Switch

A high-potential oil-break electrically wound time switch, type T, has been developed by the Albert & J. M. Anderson Manufacturing Company, Boston, Mass.

Pipe Fittings

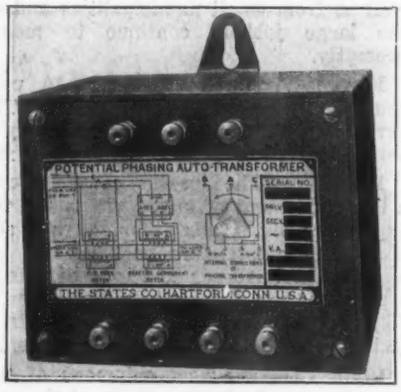
Threadless pipe fittings for switchboard construction are being marketed by the McIntire Corporation, 35 Vesey Street, Newark, N. J.

Wireless Receiver

A short-wave regenerative receiver has been developed by A. H. Grebe & Company, Inc., Richmond Hill, N. Y.

Phasing Auto-Transformer for Power-Factor Measurements

A special phasing transformer designed to simplify power-factor measurements is being placed on the market by the States Company, Hartford, Conn. It obviates the use of a special constant in interpreting meter registrations, the manufacturer says, and does away with the necessity for readjusting a meter for direct registration at a voltage below the normal voltage of the circuit. The transformer supplies 90-deg. lagging potential at normal volt-

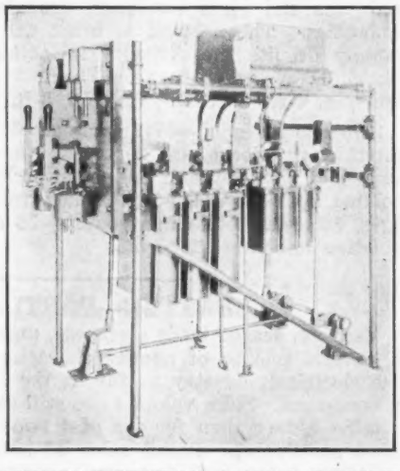


ORDINARY METER USED IN TAKING REGISTRATIONS

age to the reactive volt-ampere-hour meter. An ordinary stock meter may thus be used and its registration taken directly.

Standard Unit Induction Motor Panels

For use with either wound or squirrel-cage motors, operating on three-wire non-grounded systems, the General Electric Company has perfected a line of standard unit induction-motor panels. These units are designed to give special protection to the motor-starting devices and switching parts



ASSURES PROTECTION AGAINST IMPROPER STARTING

from abnormal electrical or load conditions or from damage due to carelessness. Time-limit relays and under-voltage devices are incorporated.

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

THE ROLLER-SMITH COMPANY, 233 Broadway, New York City, announces certain recent changes in its sales organization as follows: G. L. Crosby, previously sales manager, is now general sales manager at New York City; M. Frankel, previously assistant sales manager, is now Western sales manager at Chicago; W. J. Shire, previously a sales engineer, is now Eastern sales manager at New York City; C. G. Kahant, previously a sales engineer, is now export manager and district sales manager at New York City. F. R. Ryan, J. E. Wood and H. D. Baker remain district sales managers respectively of the Chicago, Cleveland and Detroit territories. In addition to the above C. M. Hunt is a sales engineer in the New York office, and M. B. Mathley is a sales engineer in the Chicago office.

THE STANDARD ELECTRIC MANUFACTURING COMPANY, 216 North Clinton Street, Chicago, has awarded contract for the erection of a five-story factory, 82 ft. x 150 ft., at 925-937 Wrightwood Avenue, to cost about $200,000.

THE M. S. WRIGHT COMPANY, Worcester, Mass., manufacturer of "Sweeper Vac" vacuum cleaners, has increased its capital stock by $750,000. Of this amount $522,400 has been issued, the proceeds being used in the purchase of the property formerly owned by the Mills Woven Cartridge Belt Company, now occupied by the M. S. Wright Company.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has taken over the plant of the Scranton (Pa.) Textile Company for the establishment of a new plant.

THE ALPHADUCT COMPANY, 136 Cator Avenue, Jersey City, N. J., has filed plans for an extension to its plant at 33-35 New Street.

THE BENJAMIN ELECTRIC MANUFACTURING COMPANY, Chicago, held its annual outing at the Forest Preserves, Desplaines, Ill., on June 12, which was attended by more than 1,000 employees, including factory men, office workers, heads of departments and executives of the company.

THE MERMAID DISHWASHER COMPANY, recently organized to take over the property and holdings of the Wolcott Manufacturing Company, Hartford, Conn., effective June 30, has established a plant in Middletown, Conn., where it will manufacture the Mermaid dishwashers. Frank E. Wolcott is president and general manager.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., is planning to erect a one-story building, 35 ft. x 218 ft., on Grand Street, near Garrison Avenue, Maspeth, L. I., to cost about $18,000.

THE ELECTRIC VACUUM CLEANER COMPANY, Cleveland, Ohio, has awarded contract for the erection of a building, 60 ft. x 80 ft., to be used as a plating shop.

THE DELTA-STAR ELECTRIC COMPANY, 2,437 Fulton Street, Chicago, is having plans prepared for the erection of an addition to its plant, one and two stories, 100 ft. x 110 ft., to cost about $40,000.

WILLIS H. GILBERT is now established at 710 Conway Building, Chicago, Ill. Mr. Gilbert is producing and selling Southern white cedar poles. He has opened distributing points at Atlanta, Washington, Birmingham, Cleveland, New Orleans and other points throughout the South and East.

THE PRICE ELECTRICAL COMPANY, Pittsburgh, Pa., has acquired a three-story building, 40 ft. x 113 ft., at 428-30 Penn Avenue, for its local works.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, East Pittsburgh, Pa., is making preparations for the erection of a new one-story shop, 100 ft. x 112 ft., to be equipped for high-power electric machine service at North Trafford.

BENJAMIN ELECTRIC'S OUTING ATTRACTS MORE THAN A THOUSAND

THE CALIFORNIA ENGINEERING COMPANY, consulting civil, mechanical, electrical, hydraulic and marine engineer, announces the opening of its offices at 131 Leidesdorff Street, San Francisco, Cal. Paul B. McKee is president of the company; Paul R. Parker, vice-president and chief engineer, and Byron H. Hurd secretary.

THE NORTH EAST ELECTRIC COMPANY, 348 Whitney Street, Rochester, N. Y., manufacturer of electrical products, has filed notice of increase in capital stock from $3,000,000 to $6,000,000.

S. F. BOWSER & COMPANY, INC., Fort Wayne, Ind., held its annual sales convention June 28 to July 2; it was the largest convention ever held by the company.

THE BURHAUS-MOORE ELECTRIC COMPANY, 29 Congress Street, Troy, N. Y., has been organized by Mr. Burhaus and J. W. Moore to do an electrical and mechanical engineering business, as well as contracting, and to deal in motors, etc. The company will make a specialty of mill work.

THE FEDERAL ELECTRIC COMPANY'S EMPLOYEE MANAGEMENT.—In an address delivered by John F. Gilchrist, president of the Federal Electric Company, on June 26, at a housewarming at the company's new plant, Eighty-seventh and State Streets, Chicago, an announcement was made that plans were in contemplation under which the employees would have a voice in the management of the company. Approximately 40 per cent of the employees are already stockholders. More than a thousand persons attended the housewarming.

THE GATE COIL COMPANY, Boston, Mass., has acquired property and a factory on Willard Avenue, Providence, which is to be remodeled for the manufacture of electric coil-winding machinery. The company is a subsidiary of the Universal Winding Company, Providence, R. I., and is capitalized at $100,000. Robert A. Leeson, 95 South Street, Boston, is president, and Frank N. French is treasurer.

THE HERMAN ANDRAE ELECTRICAL COMPANY, Milwaukee, Wis., announces the appointment of George H. J. Andrae as assistant to the president of the company. Mr. Andrae is a graduate of the University of Wisconsin and of the engineering course of the Westinghouse Electric & Manufacturing Company. Since his discharge from the Army he has been industrial heating specialist for the Westinghouse Electric & Manufacturing Company in New England.

THE ALLENTOWN STORAGE BATTERY COMPANY, Allentown Pa., which has been established for three years, has recently filed articles of incorporation with a capital stock of $100,000. The company does a general jobbing business and operates twelve battery and five service stations. George D. Fisher is president and William T. Kedward is manager.

THE PACENT ELECTRIC COMPANY, 150 Nassau Street, New York City, has established an advisory and consultation service for electrical dealers and jobbers who handle wireless equipment.

THE NATIONAL SPECIALTIES COMPANY, Lightner Building, Detroit, Mich., has established a branch office in the Marion Building, 1243 West Third Street, Cleveland, Ohio, where a full line of Tungsol tungsten and nitrogen lamps, carbon and miniature lamps and Atlas four-in-one fuses will be carried. F. C. Hawkins, formerly with the Westinghouse Lamp Company in Detroit, will be in charge.

THE STRITE AUTOMATIC TOASTER COMPANY, Plymouth Building, Minneapolis, Minn., has established branch offices in leading cities for the distribution of its automatic toaster for use in restraurants and hotels. Hector C. Adams, Inc., eighth floor, Grand Central Palace Building, New York City, has charge of the distribution in the Atlantic Coast States. The company has a branch office at 106 North La Salle Street, Chicago, and the Pacific Coast territory is taken care of by two of the leading jobbers in that section of the country.

CLAIMS AGAINST ELECTRIC MACHINERY COMPANY.—The Minneapolis (Minn.) Trust Company, receiver for the Electric Machinery Company, is circulating forms to be filled in by all creditors of that company having claims against it. These forms are to be filed by thirty days from July 12.

THE COLUMBUS MANUFACTURERS AND JOBBERS' ASSOCIATION has appointed Oscar Avery of the Avery-Loeb Electric Company, Columbus, Ohio, as chairman of the community conference.

THE BALSA REFRIGERATOR CORPORATION has just moved from 149 West Thirty-sixth Street to 50 East Forty-second Street, New York City.

THE ELECTRIC SALES COMPANY, Ranger, Tex., has recently been organized to handle the sale of electric lighting plants and electrical apparatus in the Southwest territory and in parts of Mexico. It will be prepared to act as the distributer of electrical material not already represented. Offices will be established at Ranger, Pecos and El Paso, Tex. The address of the temporary office at present is care Brooks-Turner Oil Company, Marston Building, Ranger, Tex.

RUSSELL A. GRIFFIN, general sales manager of the National Pole Company, died of pneumonia July 14 at his home. He was for many years connected with the American Telephone & Telegraph Company and later with the Western Electric Company, before going into the pole business.

ROBERT M. EAMES, export manager, Bryant Electric Manufacturing Company, Bridgeport, Conn., has been elected president of a newly formed Export Managers' Club, which has for one of its objects the obtaining and increasing of foreign trade for Bridgeport industries.

THE C. S. BIGSBY COMPANY, 190 Boylston Street, Boston, Mass., distributer of the New Premier electric vacuum cleaner, has established a branch office at 27 Eddy Street, Providence, R. I., in charge of C. C. Bruler.

Supply Jobbers' Notes

THE MILNER-FLOWER ELECTRIC COMPANY, Buffalo, N. Y., has established a branch house at Ithaca, N. Y.

THE ROCHESTER ELECTRICAL SUPPLY COMPANY, 100 St. Paul Street, Rochester, N. Y., has filed notice of increase in capital stock from $100,000 to $250,000.

Foreign Trade Notes

GERMAN ELECTRIC MANUFACTURING INDUSTRY'S NEW PRICE SCALE.—A notice given out by one of the largest electric manufacturing concerns in Germany states that the development of prices in the last few months has been such that the premiums added to the prices asked in pre-war times have reached almost 1,000 per cent. It is taken for granted that prices will never again be so low as they were in times of peace. The firms composing the price-fixing board of the Zentralverband der Deutschen Elektrotechnischen Industrie have therefore decided to increase the basic prices and reduce the premiums accordingly. After thorough investigation and careful calculations, the price-fixing board has concluded to fix the basic prices at three times what they were before the war. These revised price scales were put in force on Jan. 1, 1920. An exception is made in prices for machinery and motors where substitute metals are employed and for machinery wrapped in copper and aluminum. For the last mentioned the basic prices have been only doubled, as they have been increased once before.

TELEGRAPHS AND TELEPHONES DECLARED MONOPOLIES OF STATE IN COSTA RICA.—The provisional government of Costa Rica has issued a decree declaring that the wireless telegraphs and telephones are state monopolies. A translation of the decree forwarded by the United States consul among other provisions states that permissions granted for wireless installations now established in the country may be revoked at any time and the respective plants may pass into the power of the state, with proper indemnification. Furthermore, the decree limits the establishment, management and exploitation of the enterprise of wireless telegraphy and telephony for international service to persons of Costa Rican origin, singly or in corporations, under the supervision and protection of the state.

IMPORTATION OF ELECTRICAL GOODS INTO POLAND WITHOUT A LICENSE.—The most recent regulations in regard to the importation of electrical goods into Poland allow all wiring and installation material, excepting candelabra, lamp globes, incandescent carbon and electric lamps, to be imported without a license, but they are subject to customs duties.

ELECTROTECHNICAL INDUSTRIES IN POLAND.—According to the Journal of the American-Poland Chamber of Commerce and Industry, electrotechnical industries are being developed on a large scale in Poland. Many electric power houses have been built and there is a marked tendency to install electricity even in the smallest towns. The demand for electric machines and apparatus, lamps, motors and installation material is very great.

THE WESTINGHOUSE COOPER HEWITT COMPANY, LTD., 11 Rue du Pont-Suresnes, Seine (Paris), France, is prepared to undertake the representation in Europe of electric washing machines. It announces that it can offer the resources of its sales organizations throughout Europe, with centers at London, Paris, Milan and Berlin, and also the facilities of its factories at London and Paris.

SMALL ELECTRIC LOCOMOTIVES IN COAL MINES IN ENGLAND.—The use of small electric locomotives in coal mines to displace pit ponies has been sanctioned by the British Home Office. These locomotives, which heretofore have been employed in iron mines as feeders from the faces to the main roads, are designed to haul a load of 10 to 15 tons on the level, or about 3 tons up a gradient of one in thirty

THE COLEMAN LAMP COMPANY, Wichita, Kan., is erecting a plant at Queen Street East and the Don Roadway, Toronto, Ont., for the manufacture of portable lamps.

THE SHADE MANUFACTURING COMPANY, LTD., Edmonton, Alta., is planning to establish a plant on Owen Sound, Ont., for the manufacture of electric washing machines.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An engineer in Italy (No. 33,258) desires to purchase machinery and motors for the equipment of a factory for tannic acid and other acids.

An electrical engineer in Brazil (No. 33,251) desires to purchase an agency for the sale of domestic electrically operated pumps of from ½-in. to 1-in. suction, capable of elevating water from 3 m. to 30 m., utilizing a 220-volt motor.

A commercial agent in Bulgaria (No. 33,254) desires to secure an agency for the sale of material for electric installations, lamps, electric wire, etc.

Agencies are desired by a merchant in France (No. 33,288) for the sale of portable electric tools, vacuum cleaners, washing machines, electrical appliances and machinery.

Trade Publications

ELECTRIC TOOLS, CARBON BRUSHES, ETC.—Gilfillian Brothers Smelting & Refining Company, Los Angeles, Cal., is circulating catalog No. 7 on its electric tools, carbon brushes and ignition parts.

ELECTRIC FURNACES.—The Electric Heating Apparatus Company, 123-125 Sussex Avenue, Newark, N. J., has issued catalog E, covering its electric "Hevi-Duty" furnaces, muffle, tube and crucible types.

FARM-LIGHTING EQUIPMENT.—The Benjamin Electric Manufacturing Company, Chicago, is circulating a small booklet, entitled "Pioneering in Correct Farm Lighting."

ELECTRIC FURNACES.—The Electric Furnace Company, Alliance, Ohio, is circulating a four-page folder, entitled "The Crisis in Fuel Oil—a Solution of the Problem," in which it describes the resistance type of Bailey electric furnaces for the melting of metals and the heating, heat treating and annealing of steel and brass, etc.

BRUSHES FOR ELECTRICAL MACHINERY.—The Morganite Brush Company, 519 West Thirty-eighth Street, New York City, has issued bulletin M.B.C. No. 1, in which it describes its different types of Morganite brushes for electrical machinery.

AUTOMATIC ADVERTISING SERVICE.—The Automatic Illuminated Advertising Corporation, 824 West North Avenue, Baltimore, Md., has published an illustrated booklet covering its automatic "Balopticon" screen service for the advertiser, educator and lecturer.

TRANSFORMERS.—Miniature catalog 4-A-1, giving a complete list of distribution transformers with prices, has been published by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

MACHINE-TOOL CONTROL.—The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has issued a forty-eight page book, entitled "Machine Tool Control—C-H Controller."

RADIUM LUMINOUS MATERIAL.—"Undark" is the title of the booklet issued by the Radium Luminous Material Company, New York City, covering the use of radium for illuminating purposes.

OIL SEPARATOR.—Bulletin No. 1130, describing its Bundy oil separator, is being circulated by the Griscom-Russell Company, 90 West Street, New York City.

MOTORS.—The Triumph Electric Company, Cincinnati, Ohio, has issued bulletin No. 2007 on the Triumph 40-deg. polyphase induction motor.

MOLDING MACHINES.—Catalog 10, issued by the William H. Nicholls Company, Inc., 2-10 College Place, Brooklyn, N. Y., describes and illustrates its molding machines.

ARC WELDING.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is distributing reprint No. 85, entitled "Analysis of Arc Welding Principles and Processes."

WOOD PRESERVER.—The C-A-Wood Preserver Company, St. Louis, Mo., is getting out a series of letters, which will be continued, on the preservation of timber, poles, etc.

ELECTRIC WATER HEATER.—The Aetna Electric Appliance Company, 40 Court Street, Boston, has issued a small booklet describing its "Hot Vent" electric water heaters.

BALL BEARINGS.—The Fafnir Bearing Company, New Britain, Conn., has published booklet No. 20 covering its ball bearings for electrically driven and other machines.

PANEL BOARDS AND CABINETS.—The Trumbull Electric Manufacturing Company, Plainville, Conn., has issued its panelboard catalog, covered by bulletins 1-2-3.

TUMBLERS.—The Whiting Foundry Equipment Company, Harvey, Ill., has issued catalog No. 153 entitled "Tumbling Mills," in which it covers its different types of tumblers for foundries.

VENTILATING FANS.—Catalog No. 721 issued by the Buffalo Forge Company, Buffalo, N. Y., describes its motor-driven fans for dye houses and bleacheries.

BATTERY STATION EQUIPMENT.—The Service Products Company, Springfield, Ohio, is circulating a booklet entitled "Automotive Service Station Equipment," in which it describes its battery service station equipment.

CONTROLLERS.—The National Electric Controller Company, Chicago, is distributing price list No. 10, descriptive of National controllers, etc.

CONDULETS.—Crouse-Hinds Company, Syracuse, N. Y., is circulating bulletin No. 1000N, on "Condulets, Mogul Obround Series."

New Incorporations

THE NATRONA (PA.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $75,000 to operate an electric light and power plant in Natrona.

THE SEQUOYAH HYDRO-ELECTRIC POWER COMPANY, Muskegee, Okla., has been incorporated with a capital stock of $10,000 by H. C. House, R. S. Cate, both of Muskegee, and F. L. House, Gore, Okla.

THE COOPER STORAGE BATTERY COMPANY, Cincinnati, Ohio, has been incorporated with a capital stock of $10,000 to manufacture storage batteries of all kinds. The incorporators are I. J. Cooper, J. D. Cloud, A. H. Brendel, H. H. Brenner and L. E. Tulley.

THE ELECTRIC SUPPLY CORPORATION, Boston, Mass., and Manchester, N. H., has recently been organized and incorporated with a capital of $100,000, to manufacture electrical goods, etc. The promoters of the new company are Earle T. Carbee, of Hoskett, N. H.; Charles K. Marston, of London, N. H.; S. R. Atwood, of New Boston, N. H., and George M. Faulkner, of Brookline, Mass.

THE MEELEY MAGNETO & PARTS COMPANY, Philadelphia, Pa., has been incorporated by W. F. Monahan, Michael J. Trochler and Raymond M. Waters. The company is capitalized at $100,000 and proposes to manufacture magnetos and ignition equipment for automobile service.

THE HERCULES MANUFACTURING COMPANY, Indianapolis, Ind., has been chartered with a capital stock of $400,000 by Jackson Carter, E. M. McDaniel and W. L. Taylor. The company proposes to manufacture electrical machinery.

THE CANNON ELECTRIC DEVELOPMENT COMPANY, Los Angeles, Cal., has been incorporated by James H. Cannon, 4034 Homer Street; John F. Torrey and Byron L. Marvel. The company is capitalized at $20,000 and proposes to manufacture electric apparatus and electric equipment.

New England States

BOSTON, MASS.—Contract will soon be awarded by the Workingmen's Co-operative Bank, 101 Tremont Street, for the construction of a bank and office building to cost about $150,000. An electric lighting system will be installed. T. M. James, 3 Park Street, is architect.

GLOUCESTER, MASS.—The Department of Utilities of Massachusetts has authorized the Gloucester Electric Company to issue 523 shares of capital stock at $110 a share, the proceeds to be used for extensions and improvements to its plant.

WATERTOWN, MASS. — Contract has been awarded to the Hugh Nawn Construction Company, 82 Savin Street, Roxbury, by the Walker & Pratt Manufacturing Company, 31 Union Street, Boston, for the construction of a stove factory to cost about $200,000. Electric light and power equipment will be installed.

GLASTONBURY, CONN. — The Central Connecticut Power & Light Company is endeavoring to interest the people of Colchester, Hebron and Neipsic Avenues to form a fire district for street lighting.

NORWALK, CONN.—Plans are under way by Westcott & Mapes, Inc., 207 Orange Street, New Haven, for the construction of a plant in the Second District of Norwalk. The first unit to be erected will be used as a rotary substation to cost about $50,000. Equipment includes two 300-kw. rotary converters with transformers, switchboard, etc.

Middle Atlantic States

ALBANY, N. Y.—The Adirondack Power & Lighting Company of Glen Falls will soon receive bids for the erection of a hydro-electric plant on the Mohawk River near Albany. The General Electric Company, it is reported, is interested in the project. Sargent & Lundy, 72 West Adams Street, Chicago, Ill., are structural and mechanical engineers.

MOUNT VERNON, N. Y.—The City Council has contracted with the Westchester Lighting Company to install and maintain an ornamental lighting system on West Third Street between Fourth and Fifth Avenues for a period of three years. Ornamental standards mounted with four 100-watt lamps will be used.

OLEAN, N. Y.—Plans are under way for the construction of an addition to the power house of the Olean Electric Light & Power Company, to cost about $100,000. Day & Zimmerman, 611 Chestnut Street, Philadelphia, Pa., are architects.

UTICA, N. Y.—Arrangements have been made by the Utica Gas & Electric Company for an issue of $1,700,000 in bonds, part of which will be used for improvements to its plant and system.

SECAUCUS, N. J.—Bids will soon be received by the Boulevard Commissions of Hudson County, Jersey City, for the installation of a motor electric power plant in the local power house, to cost about $30,000.

BETHLEHEM, PA. — The Chamber of Commerce contemplates the erection of a ten-story hotel in Bethlehem to cost about $500,000. Electric light equipment will be required. Verus T. Ritter, North American Building, is architect.

PHILADELPHIA, PA.—The Philadelphia & Reading Railroad contemplates the erection of two electric substations.

SCRANTON, PA. — Contract has been awarded to E. A. Fuller Company, Dickson Avenue, by the Linder Brothers for the construction of a garment factory to cost about $160,000. Electric light equipment and 100 electric motors of ¼ hp. for sewing machines will be installed.

SCRANTON, PA.—Fred Nelson, architect, Connell Building, is preparing plans for the erection of a handkerchief factory, owner's name withheld, to cost about $100,000. Electric light and power equipment will be required.

BALTIMORE, MD. — Plans are under way by the Consolidated Gas, Electric Light & Power Company, for the erection of a new power plant at Dundalk.

BALTIMORE, MD. — The Miller Safe Company, Fremont Avenue and Frisco Street, will soon award the contract for the erection of the initial unit of its proposed new plant, to include power house, machine shop, etc., at a cost of about $400,000, including equipment.

WASHINGTON, D. C. — The following appropriations have been made by Congress: Engineer department, for maintenance and repair of searchlights, electric light and power equipment for seacoast

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

fortifications, and for tools, electrical and other supplies to be used in their operation, including purchase of reserve lights, $60,000; for the installation and replacement of electric light and power plants at seacoast fortifications and purchase and installation of searchlights for seacoast defense in the United States, including searchlights for anti-aircraft defenses and accessories therefor, for salaries of electrical experts, etc., $566,250; purchase and installation of searchlights for the defense of the most important harbors in the Philippine Islands, $2,000, and in the Hawaiian Islands, $50,000; maintenance and repair of searchlights, electric light and power equipment for seacoast fortifications, tools, etc., in the Philippine Islands, $25,000, and in the Hawaiian Islands, $7,000. Chief of Coast Artillery, for the construction of fire control stations and accessories, including not to exceed $48,755 for lands and rights-of-way, purchase and installation of necessary lines and means of electrical communication, including telephones, dial and other telegraphs, wiring and all special instruments, apparatus and materials, coast-signal apparatus, subaqueous, sound and flash ranging apparatus, including their development, salaries of electrical experts, etc., $770,000. Chief Signal Officer, for operation and maintenance of fire control installations at seacoast defenses, $165,000.

North Central States

DETROIT, MICH.—Plans have been filed by the Detroit Tool Company, 1487 St. Antoine Street, for the construction of a two-story addition to include a power department.

DETROIT, MICH.—The Michigan Creamery Company, care of Samuel Raboniwitch, Ford Building, has plans well under way for the construction of a creamery plant to include a steam-power plant. Electric lighting and miscellaneous power equipment will be required. Thos. A. Hyland, 307 Moffat Building, is architect.

CINCINNATI, OHIO.—Contract has been awarded to the Foundation Company, Front and Rose Streets, by the Union Gas & Electric Company for remodeling a warehouse into an electric substation, to cost about $40,000.

GEORGETOWN, OHIO. — Contract will soon be awarded for the installation of an electric lighting plant in Georgetown. E. Young is clerk.

WARREN, OHIO. — The Warren Hotel Company, care of F. E. Robbinson, Guardian Building, Cleveland, is having plans prepared by Moulthrop & Nichols, architects, 5716 Euclid Avenue, Cleveland, for the erection of a hotel to cost about $1,000,000. Electric light and elevator equipment will be installed.

RICHMOND, IND.—An appropriation of $100,000 has been ordered by the City Council as a portion of the amount to be expended for additional equipment for the municipal electric light and power plant.

WASHINGTON, IND.—Bids have been received by the City Council for the construction and operation of a municipal electric light plant to be erected at East Side Park. A bond issue of $83,495.95 for the new plant has been approved.

BREESE, ILL.—The erection of an electric distribution line from Breese to Aviston, including necessary transformer stations, poles and wires, is contemplated. Fuller & Beard, Chemical Building, St. Louis, Mo., are engineers.

ROSCOE, ILL.—Funds to the amount of $4,500 are being raised by the citizens of Roscoe for the erection and equipping of an electric light plant. The Beloit Water, Gas & Electric Company will erect a line from Rockton to supply the power.

KEWANEE, ILL.—The City Council has approved the plan now before the Chamber of Commerce for the installation of a modern street-lighting system in the business section of Kewanee.

ROCK ISLAND, ILL.—An appropriation of $20,000 has been made for the maintenance and operation of a power plant at the Rock Island Arsenal.

AMBERG, WIS. — The development of water power at the Pike River dam for the purpose of furnishing light in Amberg is contemplated.

FLORENCE, WIS.—Bids will be received by C. R. Johnson, secretary of the committee on waterworks improvements, until Aug. 15 for furnishing, f.o.b. Florence, three centrifugal motor-driven pumps, rating from 100 gal. to 500 gal. per minute; two operating panels equipped with automatic controller, meter, etc.; one electric siren and one small air compressor. Further information may be obtained on application to W. G. Kirchoffer, engineer, 31 Vroman Block, Madison.

VESPER, WIS.—The Wood County Rural Electric Company, recently incorporated with a capital stock of $100,000, contemplates the erection and operation of electric light, heating and power systems in Wood and Portage Counties.

CARTHAGE, MO.—A second election has been held and bonds to the amount of $100,000 have been voted for improvements and extensions to the electric light plant and waterworks.

MARSHALL, MO.—Bonds to the amount of $90,000 have been voted for the installation of an electric light and water plant.

ST. LOUIS, MO.—Plans are under way for the establishment of a municipal electric lighting system to cost about $1,000,000.

GRAND FORKS, N. D.—Contract has been awarded to the Fegles Construction Company, Minneapolis, Minn., by the Industrial Commission of North Dakota, for the erection of a power plant, reservoir and filter plant. C. L. Pillsbury, Metropolitan Life Building, Minneapolis, Minn., is engineer.

CLATONIA, NEB. — The local electric power plant of H. W. Steinmeyer is reported to have been partially destroyed by fire, causing a loss of about $15,000.

Southern States

ALBEMARLE, N. C. — The Southern Power Company of Charlotte contemplates rebuilding its power station recently destroyed by fire.

BLADENBORO, N. C. — Bonds to the amount of $10,000 have been voted for improvements to the lighting system, streets, etc., in the town.

BAMBERG, S. C. — At a recent local meeting, bonds to the amount of $15,000 were voted for repairs to and the enlargement of the municipal electric light plant.

UNION, S. C.—Bonds to the amount of $30,000 have been voted for improvements to the municipal electric light system.

WOODBURY, GA.—Improvements to the electric light and water systems to cost about $35,000 are contemplated. S. P. Wilburn is city clerk.

HOMESTEAD, FLA.—The city officials are considering the installation of an electric light system to cost about $15,000.

PIGGOT, ARK.—The Myers Stave & Manufacturing Company, J. R. Myers manager, contemplates the construction of a plant including a main factory and a power house, 40 ft. x 60 ft., to cost about $400,000.

NEW ORLEANS, LA. — Contract will soon be awarded by the Arabi Packing Company for the construction of a packing plant to include a power house, 57 ft. x 67 ft., to cost about $400,000. Packer's Architectural Engineering Company, 431 South Dearborn Street, Chicago, Ill., are architects.

COLLINSVILLE, OKLA.—The erection of a dam on the Caney River, with a new intake pumping station and the installation of a 350-kva. generator and 250-hp. boiler, is contemplated by the city officials. The cost is estimated at about $120,000.

ERICK, OKLA.—Improvements to include the installation of a sewer system and additions to the electric light and water plant are contemplated at a cost of about $120,000.

DALLAS, TEX.—Application has been made to the City Commission by the Dallas Power & Light Company for permission to issue $700,000 in bonds for improvements to its plant.

EDINBURG, TEX.—The Edinburg Commercial Club is interested in plans for a local electric light plant. Marvin W. Harms is secretary.

MARBLE FALLS, TEX.—The Syndicate Power Company has been reorganized by Col. C. H. Alexander of Dallas to carry out the deferred construction of a large dam across the Colorado River, partly finished, and the installation of a hydro-electric plant to develop 100,000 hp. The cost of the project is estimated at about $8,000,000, including the erection of electric transmission lines to San Antonio, Austin and other towns within a radius of 150 miles.

Pacific and Mountain States

BEND, ORE.—Announcement has been made by Charles A. Brown, president of the Bend Water, Light & Power Company, that the development of power on Tumalo Creek will be started definitely this summer or early fall. The cost of the project is estimated in excess of $250,000.

ENTERPRISE, ORE. — The Enterprise Electric Company will have work started soon on the construction of a hydro-electric plant above Wallowa Lake. The first unit to be installed will consist of one Henry impulse turbine operating under a head of about 800 ft. and one 800-kw., 514-r.p.m., 6,600-volt, 60-cycle, three-phase generator.

BONIFAY, CAL.—The extension of the electric lighting system in Bonifay is under consideration.

BURBANK, CAL.—At a recent election bonds were voted for improvements to the electric light and power plants.

LA MANDA PARK, CAL.—The Board of Trade will start a campaign soon for the purpose of securing a lighting system for this place.

LOMPOC, CAL.—The Board of Supervisors has awarded contract for installing the Los Alamos street-lighting system to the Midland Counties Public Service Company of San Luis Obispo.

LONG BEACH, CAL.—The installation of an electric street-lighting system on a portion of Fourth Street is contemplated. W. C. Waughop is city clerk.

MOORPARK, CAL.—At a meeting held recently, the proposal to establish a lighting district in Moorpark was carried.

WORLEY, IDAHO.—Bids will be received by the Board of Trustees until Aug. 7 for the erection of an electric distribution line in Worley and a transmission line from that village to Plummer, also for furnishing all materials required in the construction of both lines.

WINSLOW, ARIZ.—A certificate of convenience and necessity to construct and operate a plant in Winslow has been granted to the Arizona Electric Company.

BRIDGER, MONT. — Surveys are being made by the Montana Power Company of Butte for the extension of the high-tension transmission line from Bridger to Bear-creek and Washoe.

SANTA FE, N. M.—The installation of new ornamental lamp standards for the street-lighting system is under consideration. W. G. Turley is city engineer.

Canada

TRAIL, B. C.—Work is well under way on the construction of an extensive water system for the Consoliated Mining & Smelting Company of Canada. In the main pumping station located on the Columbia River there will be installed three 200-hp., 550-volt motors direct-connected to three three-stage centrifugal pumps, the latter operating against a head of 337 ft. and rating 1,500 r.p.m. Water will be pumped through a reservoir to a relay station to be equipped with two pumps similar to those in the main pump house. The company is also making additions to its copper plant, necessitating the installation of a 1,200-kva. synchronous motor-generator set.

LIVERPOOL, N. S.—Plans are under way for the construction of a local power plant to cost about $30,000. Smart & Burnett, 10 Cathcart Street, Montreal, Que., are engineers.

KENORA, ONT.—The Lake of the Woods Pulp Mill Company contemplates the development of water power at Kenora. The cost of the project is estimated at about $1,000,000.

SAN JOACHIM, ONT. — The Rochester Telephone Company contemplates rebuilding and altering its system completely, at a cost of about $15,000. Plans include the installation of new equipment, changing lines and making extensions. F. A. Trepanier of San Joachim is engineer.

TORONTO, ONT. — The Grinnell Company, Ltd., has awarded contract to the Anglin-Norcross Company, Ltd., for the construction of a foundry building 100 ft. x 150 ft. Electric light equipment and motors will be installed.

TORONTO, ONT.—General contract has been awarded to Witchall & Son, 156 St. Helens Avenue, by the Toronto Electrical Commissioners, Duncan and Nelson Streets, for the erection of a hydro substation.

CHELSEA, QUE.—Gilmour & Hughson of Hull contemplates the development of water power in Chelsea. The Royal Securities Company of Montreal is interested.

MONTREAL, QUE. — Plans are under way for the construction of a ten-story hotel, to cost about $8,000,000, for the United Hotel Company. Two floors will be utilized for the accommodation of power, heating and ventilation equipment, also for laundry, kitchen, etc. Ross & Macdonald, Belmont Street, are architects.

SASKATOON, SASK.—Extensions to the electric light and power plant, to cost about $27,300, are contemplated. A. Leslie is city clerk.

Record of Electrical Patents

Notes on United States Patents

(Issued July 6, 1920)

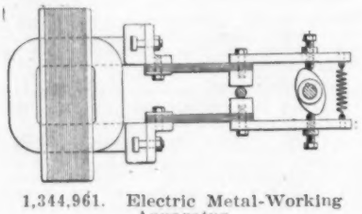
1,344,961. ELECTRIC METAL-WORKING APPARATUS; Wolcott Remington, Lynn, Mass. App. filed Oct. 4, 1919. For heating blanks fed into machine.

1,345,351. JOURNALED CABLE CLAMP; Edwin L. Crosby and Oliver J. Marshick, Detroit, Mich. App. filed Oct. 31, 1919. To be used for lessening bending strain on flexible cables of rotatable electric furnace.

1,345,768. ELECTRICAL APPLIANCES; Harold P. Hastings and John J. Dossert, Syracuse, N. Y. App. filed June 24, 1918. Socket outlet applied to conduit.

(Issued July 13, 1920)

1,346,104. ELECTRIC POCKET LAMP; Conrad Boltshauser, Zurich, Switzerland. App. filed Dec. 24, 1917. Compact case construction.



1,344,961. Electric Metal-Working Apparatus

1,346,108. BRUSH RIGGING FOR DYNAMO-ELECTRIC MACHINE; Edward F. Andrews, Chicago, Ill. App. filed March 28, 1919. Mounted on pins on frame.

1,346,164. ARC-WELDING GENERATOR; Alan M. Bennett, Westfield, N. J. App. filed March 9, 1918. Produces the desired current when striking arc and during welding.

1,346,181. AUTOMATIC REGULATOR; Henry R. Davies, Toledo, Ohio. App. filed May 13, 1918. Constant voltage from variable-speed generator.

1,346,213. CONTINUOUS-CURRENT DYNAMO; Fritz Kesselring, Neuhausen, Switzerland. App. filed July 17, 1916. Constant voltage at variable speed.

1,346,353. HEAT AND VAPOR BATH CABINET; Edgar B. Ullman, Eugene B. Simmonds, and Arthur F. Atkinson, Muncie, Ind. App. filed Sept. 16, 1918. Electrically heated.

1,346,368. ELECTRIC CIGAR LIGHTER; Charles F. Cuno, Meriden, Conn. App. filed March 8, 1920. Used on automobiles.

1,346,418. CURRENT-REGULATING PLUG AND SOCKET SWITCH; Antonio Papini, Philadelphia, Pa. App. filed Aug. 15, 1919. Rheostat in socket.

1,346,471. AIR-DIFFUSION MACHINE; Vern Slater, Iowa City, Iowa. App. filed Jan. 3, 1919. Delivers electrically heated air.

1,346,476. STRING MESSAGE HOLDER FOR WIRELESS OR OTHER TELEGRAPH MECHANISM; Montraville M. Wood, Berwyn, Ill. App. filed April 4, 1919. Knots on string close contacts.

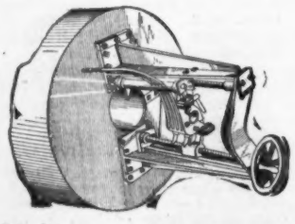
1,346,493. ILLUMINATED SIGN; William P. Hammond, Passaic, N. J. App. filed April 30, 1915. Any desired design may be shown.

1,346,522. AUXILIARY SPARK GAP; Harvey P. Altman, Findlay, Ohio. App. filed March 30, 1918. Attached to plug to increase spark.

1,346,525. BINDING POST; Frank G. Beetem, Washington, D. C. App. filed Feb. 6, 1919. Cannot rotate in its support.

1,346,539. FAIR LEAD; George F. Gray, Pittsburgh, Pa. App. filed April 22, 1919. Insulating bushing for floor of airplane.

1,346,540. SIGNALING APPARATUS; George F. Gray, Pittsburgh, Pa. App. filed May 20, 1919. Visual indication of radio waves.



1,345,351. Journaled Cable Clamp

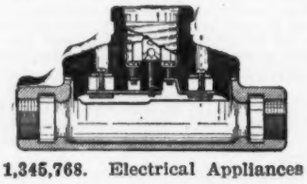
1,346,544. MAGNETIC ORE SEPARATOR; August F. Jobke, Pittsburgh, Pa. App. filed April 24, 1918. Specially shaped electrodes.

1,346,592. FIELD-COIL TESTING DEVICE; Jasper F. Cullin, Detroit, Mich. App. filed Jan. 26, 1920. For determining condition of insulation.

1,346,598. STARTER FOR INTERNAL-COMBUSTION ENGINES; Frank E. Fisher, Detroit, Mich. App. filed Feb. 24, 1919. For use on a Ford automobile.

1,346,606. ELECTRICAL APPARATUS; Christian M. Petersen and Oscar J. Boden, San Francisco, Cal. App. filed June 4, 1919. For energizing magnets.

1,346,614. METHOD OF RECEIVING TELEGRAPH SIGNALS; Chester H. Teegarden, Washington, D. C. App. filed Sept. 9, 1918. Supplementary station attached to simplex Morse line.



1,345,768. Electrical Appliances

1,346,631. ELECTRIC RIVETING MACHINE; Paul M. Benedict, New Haven, Conn. App. filed March 6, 1916. Rivet clinched while heated electrically.

1,346,659. ADJUSTABLE LAMP SUPPORT; Max Kossmann, Brooklyn, N. Y. App. filed Dec. 27, 1919. Supports lamp and cord.

1,346,693. MEANS FOR POSITIVELY INDICATING THE CONDITION OF STEEL DURING HEAT TREATMENT; Charles O. Bastian, London, England. App. filed May 10, 1920. Indicates point of critical temperature.

1,346,694. ELECTRICAL CONDENSER; Ernest A. Bayles and Harold Higham, Helsby, England. App. filed Feb. 23, 1915. For higher voltages.

1,346,698. ELECTRICAL FIRE-LIGHTING ATTACHMENT FOR STOVES; Tito L. Brunelli, Clearfield, Pa. App. filed Dec. 16, 1919. Power derived from house wires.

1,346,741. ELECTRICAL SUPERHEATER; Shady D. Colvin, Myrtis, La. App. filed July 19, 1919. For electrically superheating steam or water.

1,346,793. ELECTRIC HEATER; William O. Bunnell and Quincy A. Gates, Wilkes-Barre, Pa. App. filed March 27, 1916. To furnish various degrees of heat.